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CONTENTS.

EDITORIAL: PAGE
Paragraphs ... 387

ILLUSTRATED ARTICLES:
Application of Electricity to Agricultural Works—III ... 389
Some Fallacies in Dynamo and Motor Design, by Prof. F. B. Crocker ... 391
Ewing's High Frequency Alternator ... 391
Electricity at the World's Fair ... 388
The Death of Dr. Werner Siemens ... 392
Open and Closed Magnetic Circuit Transformers ... 392
Chronological History of Electcicity by F. P. Mottelay ... 393
Life and Efficiency Tests of Incandescent Lamps, by C. P. Feldmann ... 395
Electric Light Engines for Steamboats ... 397
E. E. & S. Snap Switch ... 398
A Surgical and Dental Motor Outfit ... 398
Queen's Deadbeat Reflecting Galvanometer ... 398
Powers' Arc Light Cut Out ... 398
The General Electric Company's Mining Locomotive ... 398

MISCELLANEOUS:
The Electrical Need of the Times—II, by H. Franklin Watts ... 390
Experiments with Primary Batteries, by G. N. Lee ... 391
New Books ... 392
Experimental Studies of the Differences of Potential Generated through Contact of Metals, Liquids and Dry Electrolytes—III. by Walter Negbaur ... 394
Commercial Electrolysis—III., by Emile Andreoli ... 395
The Edison Lamp Patent Suit ... 396
Telegraphing Without Wires ... 397
The Society of Naval Architects and Marine Engineers ... 397
Electrical Measurements in the Ewing Test of the Parson's Steam Turbine ... 399
Obituary; Geo. H. Meeker ... 399

FINANCIAL INTELLIGENCE: The Electrical Stock Market, 399; New Incorporations, 400.

SPECIAL CORRESPONDENCE: New York Notes, 400; Western Notes, 400; New Eng. Notes, 400; Canadian Notes, 400; Legal Notes, 401; English Notes, 401; Personals, 402;

NEWS OF THE WEEK: The Electric Light, 386; The Electric Railway, 385.

INDUSTRIAL AND TRADE NOTES ... 402

BUSINESS NOTICES ... 402

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS ... 402

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A Rival of the Incandescent Battery Lamp.

WHILE electricians have been at work trying to make cheap and simple portable electric lamps with batteries attached for domestic purposes, the Austrians have been busy with a so-called "elektra" incandescent lamp—called "elektra" simply to deceive the public, who have a natural weakness toward anything electrical. There is nothing electrical about it at all as it is run with an explosive petroleum compound. It is a portable or independent lamp in which an incombustible body is kept incandescent by a gas, as in that is known here as the Welsbach incandescent gas burner. The gas is obtained from a volatile distilled product of petroleum called "electroline." One filling of about 1¼ pounds of this compound is said to run the lamp for 20 hours (the candle power not being given !), to which we might add, provided the lamp does not explode before the 20 hours are up. The cost of the liquid for this lamp is at the value of less than one-half a cent per hour, the candle power not being given. Probably the liquid is of the benzine order, or perhaps even worse. Primary battery lamps therefore no longer have any showing in this field, unless the fact that they are non-explosive is of value to the user.

America's Great Inventions in the Eyes of a Bullying Englishman.

MANY slurring remarks have been made by Englishmen on the value of American inventions and on the development of industries in this country, but they are generally thin and often absurd, and may be passed over as having no more effect than water on a duck's back. Sometimes their claims for priority are just and sometimes they are doubtful, in both of which cases they should be, and are, respected on this side of the water, but when it comes to such sweeping assertions as those made recently at a public meeting by a man presumably of good standing who ought to be better informed, they certainly are ridiculous in the extreme. This man was saying what he knew (?) about electric railways, and after remarking that America had "almost" stolen a march on the Englishmen in regard to electricity, the report says that "he declared that all the solid inventions of the past 50 years had been made in England." Perhaps he means that the telephone, the electric railway, the sewing machine, and other great American inventions are not "solid," or perhaps it was a typographical error, as he may have meant to say, "prior to 50 years ago" Or, perhaps, these "solid" inventions have been lying dormant in England during the past 50 years and have not yet been developed so as to make them of any practical use; if so, it might be well to ship them over here for development.

The Edison Lamp Suit.

ON the fourth day of last October the U.S. Court of Appeals rendered a decision sustaining the decision of the lower court and the validity of the Edison incandescent lamp patent, but it appears that this was but the beginning of the end. The United States Electric Lighting Company, the party in the former suit, turned over its lamp manufacturing business to the Sawyer-Man Electric Company, and an injunction was secured by the Edison interests against the Sawyer-Man Company. Last week the case was heard on appeal before the United States Circuit Court of Appeals, and full abstracts of the arguments on either side will be found elsewhere in this issue. This was virtually a re-opening of the old suit, but on somewhat different grounds. The defendant claimed that no injunction should be granted, on the ground that the real party in interest, the General Electric Company was a trust, and that the granting of such an injunction would operate in aid of an inequitable and illegal combination in restraint of trade, tending toward unlawful monopoly. The respondents, however, claimed that there was not the slightest ground for such a charge, and that as a matter of fact, the General Electric Company could not be regarded as a party to the suit. The decision will be of unusual interest and it is thought that the judges will not delay long in handing it down.

Sixty-four-Inch Discharges.

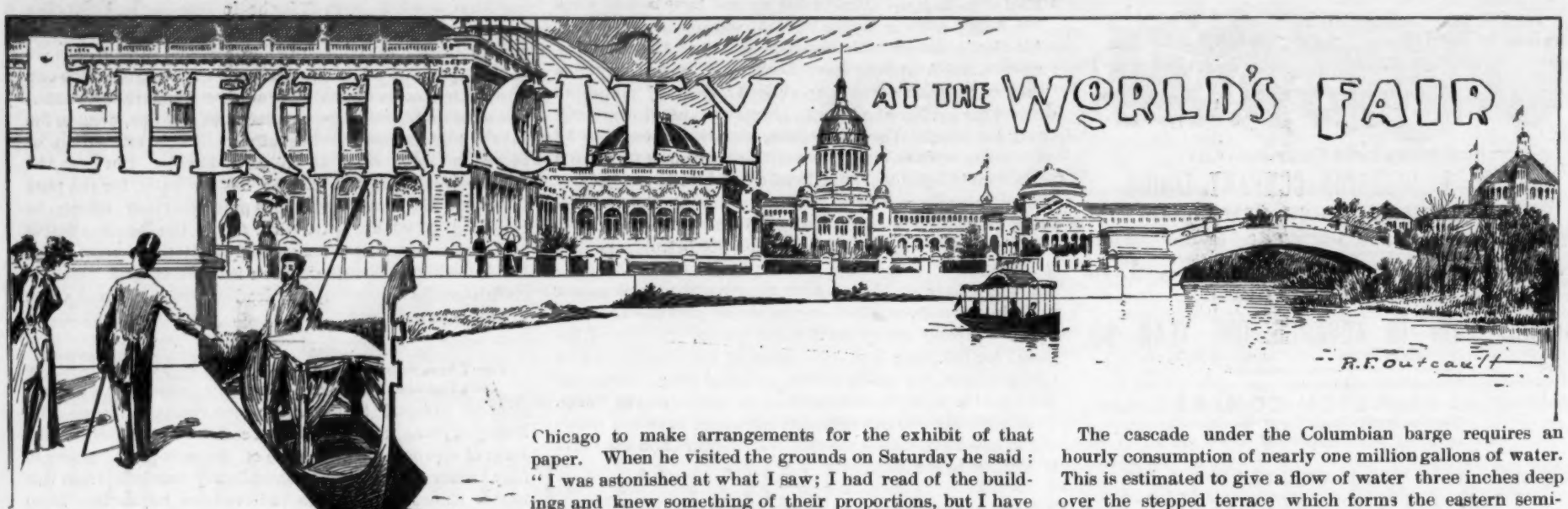
IN our issue of April 2d we published a cut produced from a photograph of an electric discharge 31 inches in length, obtained by Prof. Elihu Thomson with alternating currents, in which he used transformers and condensers. This was far superior to anything before accomplished in that direction; for, although the great Spottiswoode induction coil gave a 42-inch spark, it was undoubtedly very thin and weak as compared with the torrents of discharges produced with the Thomson apparatus. Since his former experiments Prof. Thomson has continued these interesting researches and has now succeeded in obtaining streams of sparks between terminals 64 inches apart, which is more than double the former length; but even this great length was limited by the mechanical construction of the apparatus and not by the greatest possible sparking distance. The actual path of the spark itself was, of course, much longer; being, possibly, as great as seven feet. A torrent of bluish-white sparks of such length certainly exceeds anything heretofore produced in high tension work. The discharge differs little in appearance from that shown in the cut referred to above, except in the enormous development of lateral discharges which leave the electrodes in all directions, forking through the air to distances of several feet and not necessarily in the direction of the opposite electrode. An interesting feature about it is, that the discharges are from a transformer having only 480 turns in the secondary, which is wound on a frame in the form of a coil about 17 inches in diameter and 28 inches long, the whole being immersed in oil. The primary through which the condenser discharges are sent, has 15 turns. The sight of torrents of such discharges, which can now no longer be termed lightning on a small scale, cannot fail to be an object of great interest to any one, even to the man whose narrow mind usually limits his estimation of things to their value in dollars and cents. But even the eminently practical man who has no taste for the pure sciences which gave birth to his profession may later on be benefited by such work as this, for in the hands of this able experimenter it is not unlikely that these researches, besides being in themselves such interesting and valuable contributions to science, may lead to results of great value in applied electricity.

The Vienna-Budapest Fast Line.

IT is now over a year since the description of the proposed high speed electric railroad between the two capitals, Vienna and Budapest, was made public and still it remains only in the form of a proposition. People of the non-progressive, old fogy order will doubtless immediately conclude from this that it shows the scheme to have been impractical from an engineering standpoint; but from recent discussions of this plan by able engineers it appears that the road was not built for the simple, wise and business-like reason that the limited traffic does not warrant the expense. The cost of this 164-mile road was estimated by the projectors to be from 48 to 56 million dollars, while the present annual traffic between the cities is only 200,000 passengers. Even allowing for an increase which would doubtless follow, it is not thought to be sufficient to make it a paying investment. The advantages of electric over steam traction become greater the greater the frequency of the trips, while the advantages increase in favor of steam the fewer the number of trains; or in other words, if the costs in the two cases were given in the form of curves having the frequency of the trips as abscissæ, the curves would intersect showing a point below which steam would be more economical and above which electricity would be cheaper. To take extreme cases, in many places it pays to run as few as one or two trains a day by steam where electricity would not be practical, while if cars are run at few minute intervals electric traction is now well known to be far superior to steam.

Candle-Power of Search Lights.

IT doubtless often creates great surprise among those accustomed to dealing only with lights of from 16 to 2,000 candles, to hear that the candle powers of search lights are in the millions and hundreds of millions, and statements to that effect are therefore often thought to be greatly exaggerated. While search lights may be somewhat overrated by the manufacturers, nevertheless their candle power is undoubtedly exceedingly great, and when the conditions are properly considered it is not so very wonderful that they should be so great. With ordinary lamps it must be remembered that the light is sent out in all directions, and that although an incandescent lamp, for instance, gives but 16 candles, it illuminates a large space all around it. If all this light could be collected, as it were, and passed out in one direction the brightness would increase very greatly. If, for instance, a lamp were inclosed in a hollow sphere one foot in diameter, having an opening in it of one square inch, and supposing it were possible to so reflect the light in the interior of the sphere that it would all pass out through this opening, then it can readily be shown that the candle power of the lamp *as seen through this opening* would be 452 times as great as it would be without this reflector. A 16-c. p. lamp would in that case give over 7,000 candles. This is assuming theoretically perfect reflection and no absorption losses. If the sphere were 2 feet in diameter the increase would be over 1,800 fold, or four times the former, as the beam of light now has only one-quarter the cross section. But in thus increasing the candle power 1,800 times it must be remembered that the space around the lamp which is illuminated is now only one eighteen hundredth as great as it was before. In a well constructed search light by far the greater portion of all the light emitted from the arc is collected, as it were, and is sent out in the form of a parallel beam, and the fact that in the latter case it is so very much more powerful is therefore not surprising. It must furthermore be remembered that such a beam of light, being composed of parallel rays, does not follow the usual law of decreasing inversely as the square of the distance. It decreases only by what is actually absorbed by particles suspended in the air, and by a small amount lost by dispersion, but both of these losses together are exceedingly small as compared with what might be termed the loss, or better, the decrease, according to the law of the square of the distance. If, therefore, such a search light were measured with a photometer at a great distance off, and its candle power calculated as usual, it is evident that the figure obtained would be that for a source which spread its light equally in all directions. It would, therefore, be very much greater, perhaps hundreds of thousands times greater than the actual candle power of the lamp. Furthermore, it would give a different result for different distances of the photometer from the lamp. While it is, therefore, quite correct to thus state the candle power of a search light, it must be remembered that the light is confined to a comparatively small beam, and that the actual candle power of the arc light by itself is very much smaller.



(By Telegraph from Our Regular Correspondent.)

The Executive Committee on Saturday last authorized the construction of a new building for the ethnological department and for the bureaus of hygiene, sanitation and charities and corrections of the Department of Liberal Arts. Upon the erection of that building depended the exhibition of the educational institutions of the country. These exhibits will not be placed in this building, but by making room in the new building for the exhibits above mentioned, it will now be possible to offer educators desirable, though somewhat limited, space in the main building on the grounds, namely that of Manufactures and Liberal Arts.

The Board of Control has fixed Aug. 7, 1893, as the date for the congress of inventors. A special committee has been appointed, of which E. Banning is chairman, and it is believed that this congress will result in the establishment of an international patent law.

The contract for printing and the control of the official catalogue was let on Saturday last to Conkey & Co., of Chicago. The catalogue is to be sold to visitors, the publishers accepting a precentage of the receipts for their payment. One floor of an immense building has already been leased for the work, and stands for 100 compositors will be immediately put in place. It is estimated that the catalogue will be as large as the entire works of Sir Walter Scott. Four tons of type will be required and 25 barrels of printer's ink. Over 200 tons of paper will be needed for the first edition. Twenty electrotypes will be made of of each page, and 10 cylinder presses will be run continually in order to complete the catalogue before May 1.

Lieut. F. N. Symonds has been put in charge of the boats at Jackson Park. He succeeds Commodore Clarke. Lieut. Symonds was strongly indorsed for the place by the club men of Chicago. He will make a schedule for lake steamers running between downtown docks and Jackson Park, and will give attention to the electric launches that run on the lagoons. The lieutenant has been relieved from duty in the United States Navy.

June 26 has been fixed as the day for the commercial travelers. A meeting has been called, Jan. 14, for the permanent World's Fair Committee.

John J. Milholland, of the New York *Tribune*, is in Chicago to make arrangements for the exhibit of that paper. When he visited the grounds on Saturday he said: "I was astonished at what I saw; I had read of the buildings and knew something of their proportions, but I have found that from the figures I had received only a suggestion of the magnitude of the palaces. The Philadelphia exposition will be but a country fair compared with the grand display that will be given at Chicago next year."

Preparations and plans for the opening ceremonies on May 1 are well under way. Secretary Culp submitted a programme to the directors on Saturday, and this, it is said, meets with universal approval. Musical numbers are being arranged by Theodore Thomas, Choral Director Tomlins and Secretary Wilson.

Oliver Wendell Holmes is preparing a poem to be read on that occasion. The programme will be a much shorter one than that prepared for the Columbian dedication. The general public will not be admitted to the opening ceremonies, and it is thought that only two to five thousand invitations will be issued.

CHICAGO, Dec. 12, 1892.

(From Our Special Correspondent.)

THE ELECTRIC LIGHTING OF THE FOUNTAINS AND LAGOONS.

At the west end of the Main Basin of the Exposition, seated on an elevated throne in an erect, imperial attitude, rides Columbia in her barge of state. Back of her rises the high dome of the Administration Building; on her left is the Electricity Building; further to the east of this the Manufactures Building, while on the right is a corner of Machinery Hall and the Agricultural Building. In front of her, at the east end of the Basin, rises the giant statute of the Republic, with outstretched arms, and off beyond the peristyle roll the waters of Lake Michigan.

The Columbian barge occupies the centre of a circular space 100 feet in diameter. From the parapet at the rear of this circle and rushing down the long steps that form the eastern half, there flows an endless cataract. Old Father Time, his scythe strapped to the rudder post, a determined and confident expression on his grizzled face, guides the bark; four spirits of the Arts and Sciences, on either side of Columbia's throne, trim their oars with care, and a group of prancing sea horses, with their vigorous riders, lead the way.

Off to the south of Machinery Hall in the pumping station, about 1,000 feet away, are the four great pumps which supply the water to these fountains and the cascade, and near by in the machinery building are the Edison dynamos that furnish current for the illumination of the fountains.

The cascade under the Columbian barge requires an hourly consumption of nearly one million gallons of water. This is estimated to give a flow of water three inches deep over the stepped terrace which forms the eastern semicircle of the circular basin in which the Columbian group is placed. The electric fountains when in operation at night will require about the same amount of water as the cascade. The pumping station which supplies these is to be equipped by the Henry R. Worthington Pump Company with four pumps having a combined capacity of forty million gallons of water per day. One of these pumps is a duplex compound vertical and stands nearly 50 feet high from its base, weighs when in operation about 400 tons and has a capacity of 15,000,000 gallons. The other pumps are all of different types and one, a duplex triple expansion, will run at a piston speed of 500 feet per minute. These pumps will also be used for fire protection, their supply in case of fire being shut off from the fountains and turned into the service mains at 100 pounds pressure per square inch.

The electric current for the fountains is supplied by two Edison 175 kilowatt generators. The color and figure variations are obtained by a complicated system of color shades and water piping. The contracts for and all the work in connection with these fountains have been let and the work is being rapidly pushed.

The illumination of the cascade is a part of the system of general illumination of the lagoons and canals which comes under the Westinghouse contract for the incandescent lighting of the grounds.

The main basin is 400 feet wide and extends in from the lake 1,200 feet between the Manufactures and Agricultural buildings, branching in front of the cascade into the north and south canals. These are 130 feet wide, the north canal running down between the Manufactures and the Electricity buildings, and terminating at the large lagoon which contains the wooded island. The south canal runs down between the Agricultural and Machinery buildings and terminates at the obelisk, at the base of which pose the four giant lions.

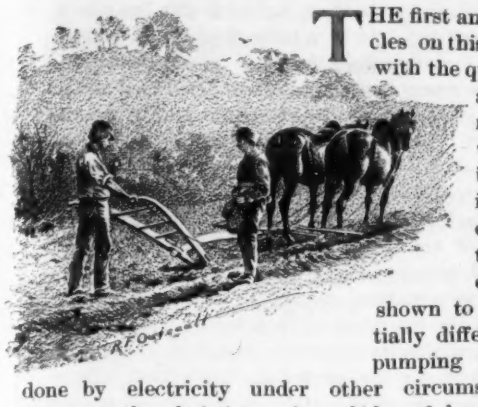
The lagoon and the canals will be outlined at night by a continuous line of 10-candle power incandescent electric lights, placed but a few feet apart and located immediately under the top of the docking which forms the water front. The flower beds, which are arranged on each side of the main basin, will be also outlined with incandescent lights, as will the entire cornice of the façade of each of the buildings which fronts on these waters.

The following table is self-explanatory:

SCHEDULE FOR ENGINES IN POWER PLANT WORLD COLUMBIAN'S EXPOSITION.

Name.	Address.	Type of engine.	Style.	Dims. cyl. in inches.	Ind. h. p. max. econ'y.	Ind. h. p. max. load.	Diam. driving pulley.	Speed.	Size steam pipe inches.	Size ex. pipe ins.	Weight engine.
E. P. Allis & Co	Milwaukee, Wis.	Quad. Exp. Cond.	Hor.	24 and 40 and 60 and 70 × 72	2,000	3,000	360 in. × 76 in. face	60	10	22	650,000
Fraser & Chalmers	Chicago, Ill.	4-Cyl. Trip. Exp. Cond.	Hor.	20 and 34 and 2-36 × 60	1,000	1,250	28 ft. × 68 in. face	64½	7	16	260,000
McIntosh, Seymore & Co	Auburn, N. Y.	Doub. Tan. Comp. Cond.	Hor.	18 and 32 × 36 doub.	1,000	1,500	16 ft. × 78 in. face	112	7	13	250,000
Buckeye Engine Company	Salem, O.	4-Cyl. Trip. Exp. Cond.	Hor.	20 and 30 and 2-36 × 48	1,000	1,300	20 ft. × 75 in. face	85	8	12	120,000
Atlas Engine Works	Indianapolis, Ind.	Comp. Cond.	Hor.	14 and 24 × 30	1,000	1,300	12 ft. × 75 in. face	150	5	8	114.000
Westinghouse, Church, Kerr & Co.	Pittsburgh, Pa.	Comp. Cond.	Vert.	21½ and 37 × 22	1,000				10	12	195.000
											Eng. and dyn.
Westinghouse, Church, Kerr & Co.	Pittsburgh, Pa.	Comp. Cond.	Vert.	18 and 30 × 16	400		8 ft. × 26 in. face	250	8	10	
Westinghouse, Church, Kerr & Co.	Pittsburgh, Pa.	Comp Cond.	Vert.	12 and 20 × 12					5	7	
Russell & Co.	Massillon, O.	Doub. Tan. Comp. Cond.	Hor.	15 and 24 × 24	506	897	10 ft. × 60 in. face	125	7	12	83,298
Russell & Co.	Massillon, O.		Hor.	13 and 20½ × 20	216	384	7 ft. × 30 in. face	180	5	8	29,898
Atlas Engine Works.	Indianapolis, Ind.	Tan. Comp. Cond.	Hor.	14 and 24 × 30	500	650	12 ft. × 36 in. face	150	5	8	57,000
Bass Foundry and Machine Works	Ft. Wayne, Ind.	Cross Comp. Cond.	Hor.	16 and 30 × 42	224	440	16 ft. × 43 in. face	70	5	10	61.000
Lane & Bodley Company	Cincinnati, O.	Cross Comp. Cond.	Hor.	16 and 30 × 42	300	350	16 ft. × 43 in. face	70	5	10	80,000
Lane & Bodley Company	Cincinnati, O.	Tan. Comp. Cond.	Hor.	16 and 28 × 42	300	350	18 ft. × 36 in. face	80	5	10	75,000
Lane & Bodley Company	Cincinnati, O.	Simple.	Hor.	18 × 42	150	200	14 ft. × 25 in. face	80	5	6	37,000
Watertown Engine Company	Watertown, N. Y.	Doub. Tan. Comp. Cond.	Hor.	9 and 16 × 14	250		60 ft. × 12 in. face	250	4¼	10	
Buckeye Engine Company	Salem, O.	Cross Comp. Cond.	Hor.	14 and 28 × 24	300	360	10 ft. × 33 in. face	50			33,000
Buckeye Engine Company	Salem, O.	Tan. Comp.	Hor.	11 and 21 × 16	150	190	76 in. × 26 in. face	215			25,000
Buckeye Engine Company	Salem, O.	Simple.	Hor.	16½ × 30	190	250	13 in. × 25 in. face	110			23,000
Buckeye Engine Company	Salem, O.	Simple.	Hor.	13 × 21	125	175	80 in. × 12 in. face	175			14.000
Buckeye Engine Company	Salem, O.	Simple.	Hor.	13 × 16	125	175	64 in. × 12 in. face	225			15,000
Ball & Wood Company	Elizabeth, N. J.	Cross comp.	Hor.	14 and 22 × 12	200	250	66 in. ×	280	5	8	
Ball & Wood Company	Elizabeth, N. J.	Tan. comp.	Hor.	13 and 20 × 16	150	200	78 in. ×	226	5	8	
Ball & Wood Company	Elizabeth, N. J.	Tan. comp.	Hor.	13 and 20 × 16	150	200	78 in. ×	226	5	8	
Ball & Wood Company	Elizabeth, N. J.	Simple.	Hor.	16 × 16	150	200	78 in. ×	226	6	7	
Ball & Wood Company	Elizabeth, N. J.	Simple.	Hor.	16 × 16	150	200	78 in. ×	226	6	7	
Skinner Engine Company	Erie, Pa.	Simple.	Hor.	16 × 18							
Skinner Engine Company	Erie, Pa.	Simple.	Hor.	16 × 18							
Stearns Manufacturing Company	Erie, Pa.	Tan. comp. cond.	Hor.	19 and 31 × 24	600	800	102 in. × 31 in. face	165	7	12	675,000
Stearns Manufacturing Company	Erie, Pa.	Tan. comb. cond.	Hor.	15 and 25 × 20	375	500	88 in. × 23 in. face	200	5	9	34,000
Phœnix Iron Works Company	Meadville, Pa.	4-cyl. trip. exp. cond.	Hor.	15 and 24 and 2-26 × 18	500		{ 2 — 108 in. × 26 in. / 1 — 108 in. × 38 in. }	200	6	14	
Phœnix Iron Works Company	Meadville, Pa.	Tan. comp. cond.	Hor.	13 and 24 × 18	250		108 in. × 26 in. face	200	5	9	
Phœnix Iron Works Company	Meadville, Pa.	Simple.	Hor.	18½ × 18	250		98 in. × 26 in. face	220	7	9	
A. L. Ide & Son	Springfield, Ill.	Tan. comp. cond.	Hor.	13 and 22 × 16	225	250	72 in. × 16½ in. face	245	6	8	24,000
A. L. Ide & Son	Springfield, Ill.	Simple.	Hor.	16 × 16	200	250	72 in. × 16½ in. face	245	6	7	18.000
E. P. Allis & Company	Milwaukee, Wis.	Cross. comp. cond.	Hor.	19 and 36 × 48	500	800	16 ft. ×	90	7	12	85,000
General Electric Company	New York, N. Y.	Triple exp. cond.	Vert.						8	18	
Armington & Sims Engine Company.	Providence, R. I.	Simple.	Hor.	18 × 21			84 in. × 25 in. face	225	7	10	
Ball Engine Company	Erie, Pa.	Cross comp.	Hor.	18 and 36 × 18	480	570	86 in. ×	225	7	18	65,000
McEwen Manufacturing Company	Ridgway, Pa.	Tan. comp. cond.	Hor.	14 and 23 × 20	220	325		200	5	10	24,000
Sioux City Engine Works	Sioux City, Iowa	Tand comp	Hor.	11 and 19 × 20	150	225	72 in. × 16 in. face	200	4½	7	16,000
Cooper, Roberts & Company	Mt. Vernon, O.	Simple.	Hor.	13 × 12	100	125	32 in. × 15 in. face	300	4	4½	9,000
Gold, Steel & Mineral Iron Works	San Francisco, Cal.	Tand. comp.	Hor.	12 and 22 × 30	200	270	11 ft. × 25 in. face	115	4	7½	35,000
Hoover, Owens & Rentschler Company.	Hamilton, O.	Tan. comp. cond.	Hor.	20 and 36 × 48			20 ft. × 50 in. face		6		
Bates Machine Works	Joliet, Ill.	Simple.	Hor.	20 × 48					6	7	
Harrisburg Foundry & Machine Works	Harrisburg, Pa.	Tan. comp.	Hor.	17 and 28 × 18			102 in. × 30 in. face	176	6	11	
Harrisburg Foundry & Machine Works	Harrisburg, Pa.	Tan. comp	Hor.	15 and 28 × 18			102 in. × 30 in. face	176	6	11	

Application of Electricity to Agricultural Work.—III



THE first and second articles on this subject dealt with the question of the application of motors to the work of hoisting and pumping, and the character of the work required was shown to be not essentially different from the pumping and hoisting done by electricity under other circumstances. For instance, the hoisting of a bale of hay in a barn on an isolated farm by an electric motor, assuming that a suitable source of power is available, differs in no essential particular from the hoisting of a bale of cotton from a ship's hold to the dock where a cargo is unloading, or the hoisting of coal from a deep mine. Neither does the pumping of water for farm use by an electric pump differ from the same class of work in other localities, as, for instance, in a small city where a system of water supply is not furnished by the municipality. This same point is to be borne in mind in the consideration of the other classes of service to which stationary motors are applicable in farm work, such as those enumerated under the third head in the tabular statement in our first article. Here it was pointed out that the electric motor was applicable to miscellaneous machines, such as threshers, grinders, shellers, cider presses, feed cutters, hay presses, grindstones, machine shop tools, wood saws, churns and coffee mills, laundry machines, horse cleaners and other similar work.

One method of application of an electric motor to a thresher is shown in Fig. 4 in our first article in THE ELECTRICAL WORLD of Dec. 3. This represents the direct method where an individual motor used for the thresher and in our illustration the motor is shown mounted upon a permanent pedestal provided for this purpose. The position of the thresher is shown by the perspective view of the barn and the diagram in Fig. 1. Another plan, entirely practicable and more suitable where the size of the farm does not warrant the permanent installation of a motor and thresher in this way, is to have the motor mounted upon a portable truck, the wheels of which, together with their axles, can be removed and the wooden frame of the apparatus so arranged as to form a sufficiently solid base upon which the motor may rest whenever used for either outdoor or indoor service, and at any part of the farmyard, or in the adjacent fields. With this type of machine current would be supplied through a flexible twin cable which when not in use, would be coiled up on a reel.

A "mounted motor" of this sort would find many uses on the ordinary farm, its portability being one of its chief features. Of course there is still another method of supplying power to a thresher when it is built permanently in place like the one shown in the illustration. The barn can be equipped with a main shaft from which several machines may be driven, and this shaft may be operated by a motor placed in the building and drawing its current from some outside source, whether that be an isolated central station on the farm, or the mains of a rural street railway line, or other source. From this main shaft the thresher might be driven in the ordinary way.

One point to be kept constantly in mind in considering the applications of electric motors to stationary farming apparatus is the intermittent character of the work. In nearly every instance power is required for short periods of time only, and in many cases for only a few days during the entire year. In the case of a thresher, for instance, it is likely that all the work of this character required on a farm for the whole year would be done at once and the machine if belonging to the owner of the farm would lie idle for the rest of the year. In other cases, such as the use of grinders, feed cutters, machine shop tools, etc., the power might be needed for one, two or more hours per day, either for a portion of the year, or every day in the year. This fact, of course, would need to be considered in arranging the tools and apparatus and the motors for driving them, since it is probable that in nearly every case the machines could be so arranged in connection with the power driving them that not more than one or two, or at the most three, would be in operation at one time. Under these circumstances a much smaller motor would be needed than if provision is made for the operation of all the machines at one time. Considerations of this kind of course are similar to those met with in the design of plants for the general distribution of power in cities, whether steam or electric. In the case of the former plants, however, the running of the machines would be under the control of one man, which is not the case in the general distribution of power where the central station has no control whatever over the operation of the motors to which current is supplied.

From the foregoing it will be seen that the portable motor, which can be taken at will to any part of the farmyard or barn, when needed, would be in many cases the most advantageous as well as the cheapest method of equipment. A motor of sufficient size to operate the largest machine would then be sufficient for the operation of nearly all the farm machines, including threshers, grindstones, feed cutters, etc. It would only be necessary to have a flexible wire connection with the source of power which could be unreeled to the desired length.

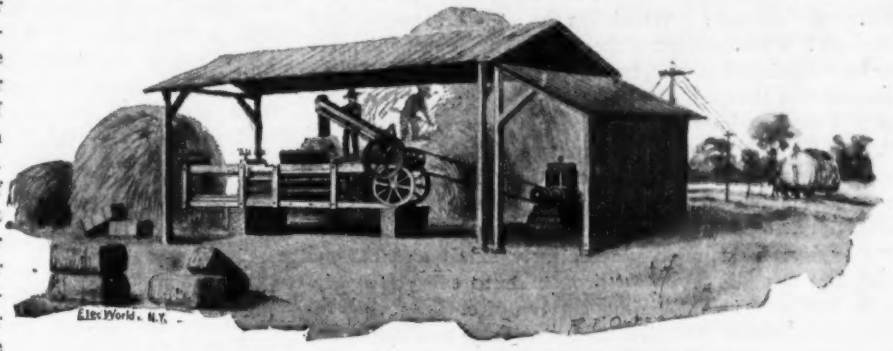
A SUGGESTION.

In Fig. 3 of the first article on this subject in THE ELECTRICAL WORLD of Dec. 3 is shown the operation of a feed cutter and corn sheller, made by the Eagle Manufacturing Company, of Lancaster, O., and operated in this instance on the farm previously mentioned, by an electric motor. Here it will be seen that the method used is that of directly driving the machines by an individual motor. The conditions of operation would not be different if the motor, instead of being placed permanently in position, as shown in the illustration, were mounted together with the necessary rheostat upon a suitable truck, so that when not wanted for the purposes of operating the feed cutter and sheller it could be taken, say to the machine shop and there connected to the machine shop mains, and used to drive lathes, saws or other tools, as shown in one of the illustrations in this issue.

The operation of a cider press is shown in one of our illustrations in the article on this subject in THE ELECTRICAL WORLD of Dec. 10. This is another instance of a class of work that is called for only at a certain season of the year, and doubtless here again a portable motor would be found fully as convenient as the permanent one and much more economical.

Another instance of this class of farm work to which the electric motor is applicable is that of the operation of a hay press, an illustration of which is shown on this page. Whether driven by a portable or a permanently mounted motor makes no difference.

The demand upon the electric motors in many classes of farm work, such as this, for instance, would be exceedingly severe. In some cases the load on the machine operated would be steady and the power called for would be uniform, but in many other instances the load would vary from that needed to drive the machine empty to an overload, the change being made instantaneously. Electric motors are now built with such sensitive regulation that changes in speed caused by fluctuations in load are almost imperceptible. Those acquainted with farm work will recognize the importance at once of a source of power which will maintain a constant speed under extreme changes of load. In threshing for instance it is often necessary where the machine is driven by horses, or even by a steam engine, to remove the load in order to let the machine speed up to its normal rate.

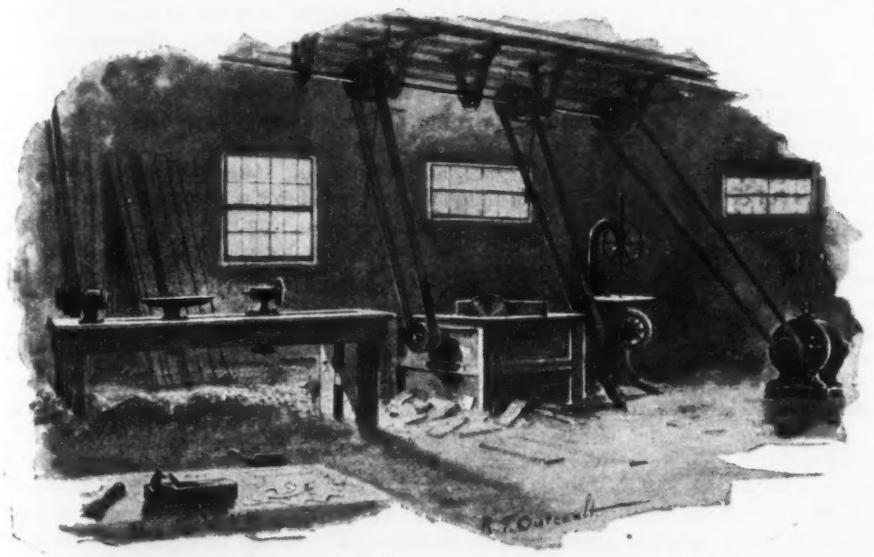


AN ELECTRICALLY DRIVEN HAY PRESSER.

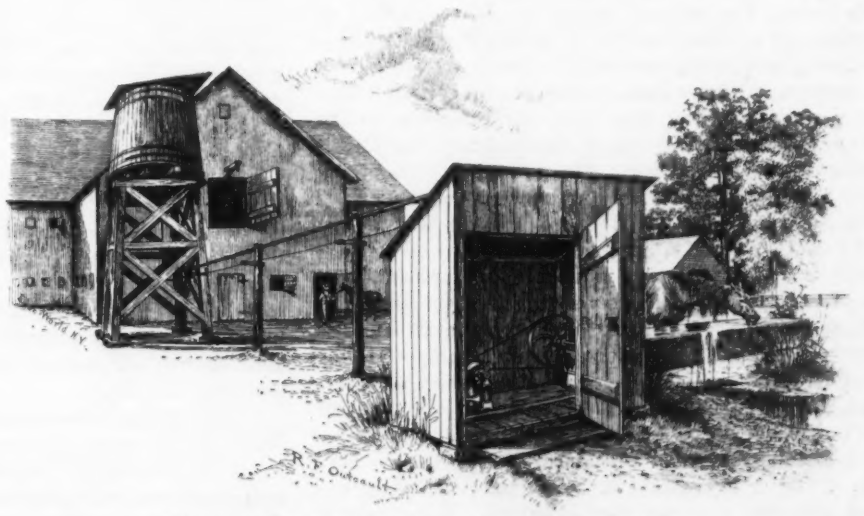
The application of electric motors to household work on the farm is illustrated by our large engraving in THE ELECTRICAL WORLD of Dec. 10. Here an ideal sketch is shown of one method for operating from a single motor a number of machines, such, for instance, as a laundry wringer, washing machine, a churn and a saurkraut machine. At the left of the illustration is also shown what is now an entirely practical method of heating flat irons by the electric current. A flexible connection is made with the iron and by the switch near at hand the current is supplied for keeping it at a constant temperature.

A PORTABLE PUMP.

It is thought by many, and probably with a good deal of reason, that the value of electricity as a household servant has only just begun to be understood. It is certain that there are very many classes of work now performed by hand—work that is drudgery to the last degree—that can with the greatest ease be done by the aid of electricity. Whatever assistance the electric pump, the electric heater, the electric flat-iron, the electrically driven sewing machine, or any other variety of electrical apparatus applied to household work, may give to the housewife or her servant will certainly be thoroughly appreciated. To the isolated character of the farm and its tenants is doubtless to be credited the fact that the electric motor has not, up to the present time, found its way into the farm house or into the farm barn to do work which it has already been found to do successfully in connection with other classes of work.



SHOP TOOLS OPERATED BY AN ELECTRIC MOTOR.



THE ELECTRIC PUMP IN FARM SERVICE.

The Electrical Need of the Times.—II.*

BY H. FRANKLIN WATTS.

If now, the frequency is reduced to 70 alternations per second, as the writer proposes, an armature 22 inches in diameter driven by a 24 inch pulley, running 700 revolutions in a six pole field, will give this frequency. This machine might easily be a 1,000, 1,500 or 2,000 light machine. Now, compare this with a 1,000 light machine of to day, giving 15,000 alternations. This machine has an armature 22 or 24 inches in diameter, making 1,090 revolutions in a 14 pole field, driven by a 16 inch or 18 inch pulley. Which is the more efficient? Which requires the greater exciting power? Which has the larger driving pulley on engine? Which on dynamo? Which has the coolest armature and bearings? Which engine is the most easily kept up (supposing both machines to be driven by separate engine)? Which machine can the most easily be self-exciting and compounding? These, and many other questions, are self-evident to all. But while high speeds and many poles are bad enough, the presence of a separate exciting machine is fully as objectionable. They are forever in the way. There seems to be no good and satisfactory way of driving them, they require little horse power, have small and narrow belts, and are greatly out of proportion to everything else in the station. Their bearings run hot oftentimes, they require considerable attention, and contribute nothing to the general output, but on the other hand are responsible for many interruptions. As alternators are built to-day, they are necessarily separate exciting. Some of the first alternators brought out were self-exciting, but these were soon found to be unsatisfactory, and while the manufacturers still claim good results from them, they always recommend the separate exciter.

TABLE OF PROPOSED SPEEDS, SIZES OF ARMATURES, PULLEYS, ETC., FOR BELT-DRIVEN ALTERNATORS TO GIVE 4,200 ALTERNATIONS.

No. of 16 c. p. lamp.	Speeds.	No. of poles.	diam. armat.	diam. pulley.
3,500 to 6,000	420	10	40 in.	44 in.
1,200 to 3,000	525	8	32 in.	35 in.
600 to 1,000	700	6	24 in.	27 in.
350 to 500	1,050	4	16 in.	18 in.
100 to 300	2,100	2	8 in.	9.5 in.

These machines, with their magnets huddled together, have very narrow neutral points, so narrow in fact that you can scarcely find room for the brushes, and a movement of $\frac{1}{16}$ inch will often cause them to spark badly; they are then very liable to suddenly lose their field and "let go," and thus become inactive for some moments. This is one great trouble with these self-exciting machines to-day. They seem to lack magnetic stability. It is evident that, by reducing the number of poles as proposed, from 14 to 6, and all other machines in proportion (see the adjoining table) the magnets will be less in number and larger. The above is contributed to high efficiency, but furthermore, the neutral points will be wide, the magnets will possess greater stability, and the machine can easily be made self-exciting and compounded or over-compounded with the greatest ease and accuracy, and will cause no trouble from sparking. The machine is thus complete in itself, and the exciter anomaly is done away with.

While it is true that, by reducing the frequency, we greatly reduce the rate of cutting in the converter; we must also bear in mind that we are giving the alternations more time to act on the iron and thus create more lines and, consequently, cut more lines, so that, within certain limits, a variation of frequency may make no difference in the output of a converter, or even in the efficiency, provided it contains a large mass of iron. The exact limit will probably be a question of saturation or magnetic density of the cores of the converter, and as this density is very low it would seem to indicate a larger range of frequency.

It will be argued that the machine above referred to, having but six poles, would be very much larger than the one having 14 poles of the same output. Suppose it is. Is this any objection? Alternators are very small per unit of output; hence we might advantageously increase their size and weight. The Edison shunt machine is very large and heavy for its capacity, but is this any objection? Is it not one of the most reliable machines of its class to-day? Again, it might be urged that the six pole alternator described will cost more per watt of output. Here there is much to be said on both sides.

The present tendency is in the direction of large machines up to 10,000 16 c. p. lights capacity, and in the case of direct current machines for light and power the method of driving direct by means of an engine and dynamo upon the same shaft is rapidly becoming a favorite. But is it not equally desirable to drive alternators direct? What then is the reason that this has never been done in this country? Simply because it was not considered practicable for mechanical and electrical reasons to produce 16,000 or 15,000 frequencies required in such machines when driven by say a Corliss engine.

Even after the direct method of driving had long become well known, there could not be found in the United States, to the writer's knowledge, a single instance of an American alternator driven direct. More recently, however, the Westinghouse Company, desiring to produce an alternator, applicable for both arc light and power, brought out a line of machine operating at 7,200 alternations instead of 16,000. Converters were also built that could be used at either frequency equally well.

Then, after this reduction in frequency had taken place, the first driven alternator made its appearance and was installed at the station of the Narragansett Electric Lighting Company, Providence. This machine has 80 poles, as many, in fact, as can be crowded together in the space allotted. The armature runs at 90 turns, giving 7,200 alternations. The armature, however, has but 40 poles (if we may judge from the illustration), showing that even 7,200 was difficult to obtain, and necessitated an armature having but half the number of poles that the field contained. The results obtained will be watched with the greatest interest by all. If, now, this machine was to make 4,200 alternations instead of 7,200 while running at 91, instead of 90, the armature being 16 feet in diameter, there would be needed but 46 poles in the field instead of 80, and 46 poles also in the armature. Would this not be an improvement, and would it not facilitate construction and cheapen the first cost of such a machine? Again, in the case of a 5,000 light belt driven machine, suppose the armature to be 30 inches in diameter, running at 700 revolutions in a six-pole field, and giving 4,200 alternations, would not this be a satisfactory arrangement?

To now drop the question of frequency and proceed. What else is needed? We need higher voltages. One thousand volts seem to be the universal pressure employed throughout the United States for light purposes. In the West we find electric transmissions employing from 2,000 to 5,000 volts by means of alternating currents, of course. As we are compelled to convert, let us convert for a purpose. Let us employ a primary pressure of 2,000 volts at least, instead of 1,000. So far as danger to human life is concerned if 1,000 volts will kill, as has been asserted, 2,000 volts cannot do any more, and there is no excuse for a man ever laying a finger on a live primary wire, or any portion of it Primary fuses can be replaced, converters can be put up and taken down while the current is on, and without danger to employés; furthermore, in the latest switchboards, there are no exposed connections, much less bus rods. All connections are carefully covered up.

What else is needed? We want carbon brushes upon everything in the station if possible. Of course, this cannot be done with arc machines, but on the collectors of the alternators, and especially on the exciters (if we are so unfortunate as to be compelled to retain them.) Use them by all means and be sure to set these brushes square, or nearly so. We find many exciters with carbon brushes set at an angle of 45 degrees, the same as copper brushes. This always causes trouble by the points of the brushes jumping up and down. In the writer's experience carbon brushes never give satisfaction unless set at an angle of 80 or 90 degrees to the commutator. It is also necessary that these brushes be pushed from the end instead of being clamped on the side. We also want carbon brushes for the commutator of the alternator if it is compounded. Everywhere we find on these commuators and on many exciters the old copper wire brushes that scratch and cut and wear grooves in the commutator and necessitate frequent filing down. In any alternating machine the neutral points are very narrow and a slight movement of the brushes will often cause them to spark, and it doesn't need much sparking to show in the lights. All in all, these commutators are the source of a great deal of trouble. For this and other reasons let us have the carbon brushes set at 85 degrees upon the commutators and directors in connection with the apparatus. What else is needed? We want alternators from 1,000 lights up driven direct by simple, compound or triple condensing engines. A great deal of credit is due Mr. Marston J. Perry, the manager of the Narragansett Electric Lighting Company for the bold step he has taken in producing in the United States the first direct driven low frequency alternator of American manufacture. What else is needed? We want our large alternators provided with friction clutches, so that engines and dynamos may be coupled and run together at the same speed, and as soon as the alternators are in step, then thrown in multiple.

Suppose a large central station be constructed to light New York City by means of alternating currents as follows: We locate the building at a distance from the city of, say, five miles, with regard to coal and water supply only. Land is cheap and our machinery can be spread out without limit. We begin by putting in a 1,000-h. p. unit. This engine we decide to be a vertical triple condensing, having three cranks at 120 degrees apart and adapted to be run at 70 turns. At one end of the main shaft is a large friction clutch capable of transmitting the entire horse power of the engine (this is not a coupler). At the other end of the shaft is an alternator having a slotted armature 20 feet in diameter and having 60 poles. There are also 60 poles in the field. Running at 70, this machine gives 4,200 alternations, and an E. M. F. of say 3,000 volts. Both the engine and dynamo are capable of being overloaded, and may, without danger, deliver 750,000 watts or 250 ampères. Its ordinary load, however, would be about 560,000 watts, or 187 ampères. Such a machine could easily be made entirely self-acting and accurately compounded or over-compounded to any desired percentage, and with none of the difficulties attending the present self-exciting alternator. To render everything complete the engine should be electrically controlled to maintain a constant voltage or to raise it slightly on load, but this is not a part of the present programme. The above dynamo could easily have a commercial efficiency of 90 per cent. or more. Let us now assume that a second unit similar in all respects to the first has been constructed and the two adapted to be clutched together. If a third unit is added it is placed in line with the others and clutched, and so on. On the switchboard well covered up and out of sight are the bus wires, into which all machines feed to a main double pole switch with long breaks and operating quickly. The bus wires are divided up into as many sections as there are units in the station, each section, however, can be connected by a multiple arcing switch with the other section, as in the Westinghouse switchboard. This enables any dynamo to supply its load independently of the others. Ordinarily, all of these multiple arcing switches are closed, thus forming a continuous pair of conductors. From these mains the feeder starts, each being provided with a regulator capable of raising the voltage on that particular feeder to 25 per cent. higher than the bus wires. Each feeder has its ammeter in circuit and also its voltmeter attached to pressure wires running back to the centre of distribution in New York City. In the main circuit of each alternator is also an ammeter. Between the machine main switches and the bus rods is connected a synchronizer in such a manner that it is in circuit so long as the main dynamo switch is open, and is cut out by the act of closing the latter switch. The synchronizer indicates, not by the lighting of lamps, but by a needle, and it indicates with the greatest accuracy.

Now, supposing one machine to be running, and it has become necessary to start another, and to connect it in multiple with the first. The engineer first starts the second engine and brings it up to speed. Its fields build up, and soon it is given its full voltage. This is regulated until it is the same as the voltage of the bus wires. The engine is allowed to run for several minutes at full speed, warming it up thoroughly, giving the governor and heavy flywheel, armature time to control the speed to a nicety. Meanwhile the man at the switchboard is watching the synchronizer. Supposing, for the moment, that the engine is controlled by a fly-ball governor. The engineer will soon learn by experience, if the alternations do not at once synchronize, whether the speed is too high or too low, and accordingly adjust the governor a slight amount. At 70 alternations per second there should be no serious difficulty in bringing them into step, especially after a little practice. As soon as they are once in step, the large clutch is closed, and then the main switch is closed, and the machines are in multiple. It then only remains to raise the voltage to give it any desired load.

Referring again to the electric governing of the engine, it is well known that the voltage of a well designed shunt machine varies nearly as the square of its speed, or to be more accurate, as the 1.75 power of its speed. Assuming the voltage of the direct current commutator of the above alternator to vary as the 1.75 power of the speed, and that this voltage controls the speed of the engine, could its speed not be controlled with the greatest accuracy? The electric governor will yet come to the front.

The writer now ventures to ask in all seriousness, what is wrong with the above arranged central station and the alternator referred to? If all units must be in line, this certainly is an objection and immense clutches would be needed, but there would be very little strain on them ordinarily. It is also believed that with the engines accurately controlled, clutches would be entirely unnecessary. The fact is, that two alternators being once in step and connected in multiple are already clutched, and cannot easily get out of step, especially if both engines are independently adjusted to maintain the same speed.

In the matter of mains and feeders for such a station as described there is probably nothing better than the Ferranti concentric cable, or a wire strung with porcelain insulators and slid into a copper tube and filled with oil to exclude moisture.

And now a word for the "dynamo" engineer. Give the central station man a hearing; the opinion of the quiet, unassuming "dynamo" man in his blue overalls and greasy jumper is often worth more to the manufacturing company than the opinion of their own electrician, so far as it concerns the operation of the machines in the station. Alternating stations are to-day operated under tremendous disadvantages for the sole purpose of obtaining a smaller and cheaper converter. The writer now proposes—not the opposite extreme, which will throw all merit into the central station and leave none for the converters—but a happy medium, which, giving good results in the converter, gives a reasonable number of poles in the dynamos, rendering them self-exciting, and in the matter of speeds conforms to good engineering practice He, therefore, proposes a frequency of 4,200 alternations per minute, or 70 per second, or 35 complete periods per second, as best fulfilling the above condition.

The probability is that, in the near future, some practical man will establish a large alternating station (we hope in the vicinity of New York), and will run his alternators in multiple, with an ease and freedom that will excite our admiration, and we will then wonder why so easy a task or so simple an arrangement was not accomplished before.

Electricians, as a class, are apt to look too low and consider a problem to be deeper and more difficult than it really is. Nature's secrets are on the surface. If a coin has fallen on a pile of loose earth the way to recover it is to stoop and pick it up, disturbing the surrounding earth as little as possible, but if we stir up all the surrounding matter with a slide rule, the coin is soon buried beneath a mass of mathematical débris and the problem is further from solution than ever.

* For the first section of this article see THE ELECTRICAL WORLD of Dec. 3, 1892.

Retracing our steps to the starting point, we may again ask, what are some of the most urgent needs of the times in electric lighting.

First—We want a direct current converter applicable to alternating circuits.

Second—We want alternating frequencies reduced to about one-quarter of the present rate.

Third—We want a reduction in speeds of all alternating armatures.

Fourth—We want alternating armature speeds to conform to standard engineering practice.

Fifth—We want all alternators to be self-exciting and compounded.

Sixth—We want our alternators running in multiple.

Seventh—We want carbon brushes on all alternating apparatus and set at 80 to 90 degrees to the commutator.

Eighth—We want alternators to be direct driven by economical engines even down to 100 h. p.

Ninth—We want but one type of dynamo in our central station, said type to render all sorts of service.

Tenth—We want higher primary voltages all round.

Eleventh—We want engines and dynamos regularly inspected and covered by insurance by a corporation whose specialty it is to do so.

"Man wants but little here below,
Nor wants that little long."

P. S.—But during the short time that he wants it. He wants it bad.

Experiences with Primary Batteries.

BY GEORGE H. LEE.

I was immensely pleased with your editorial in THE ELECTRICAL WORLD of Nov. 12 on "Electrical Quacks," also with the experiences of a correspondent with wonderful primary batteries. Many times I have intended to write an article on the same subject and give vent to my outraged feelings, as I have, to my sorrow, given the subject much attention.

I have purchased and tested many of the much-lauded primary batteries, and analyzed several of the depolarizing powders and solutions, and find that while some of them will give the advertised current and voltage for a very short time after first being set up, the advertised facts of "no local action," "100 to 300 ampère hours," "no fumes," etc., have been, without exception, false. That "no fumes" nearly ruined a fine lot of tools for me before I realized the fact that all men are not truthful, and also consigned me to the care of a physician for a week on account of fumes inhaled. If these manufacturers of primary batteries would advertise "no visible fumes" they would be correct. On analysis of the depolarizating powder sold by most of these firms I find it to consist of ammonium chloride, .25; potassium nitrate, .75; with, in some cases, a little coloring matter as a disguise, which is quite convenient, as the combination is sold in most cases at the net profit of 1,000 per cent.

In the ordinary Bunsen or Grove battery using nitric acid, or one of its salts, in combination with sulphuric acid as a depolarizer, the fumes generated are of a reddish color, very irritating to the nostrils, and corrosive of metallic surfaces which may be exposed to its action,

The combination of salts in the new depolarizing solution gives, with the solution of sulphuric acid and the heat generated by the addition of the acid to water in the quantity given, a solution of chlorine as the active depolarizer. This, in combination with the hydrogen which forms on the negative plate during action, becomes hydrochloric acid gas, which is given off from the battery during action, and is equally as corrosive and disagreeable as the NO_2 given off from the Bunsen or Grove battery.

To the amateur who has possessed nothing stronger than a gravity cell and who has no instruments for electrical measurements, these batteries do, no doubt, seem wonderful, and startling testimonials are the result. Other recommendations are secured from electricians and others from a short trial of a new cell. In these very battery cells which are advertised as having "no local action," the zincs require re-amalgamation every two or three days to secure anything like decent results.

The solution must also be used immediately. As heat is absolutely necessary for its preparation (no result being obtained if the powder is added to the sulphuric acid and water after it becomes cold), so, on standing for a few days, the depolarizing agent liberated by the heat reunites with the salts contained in solution and becomes as valueless as a depolarizer as so much water.

Many are the amateur electricians at work throughout the world. Some are fully equipped with apparatus, tools and necessary funds. Others are laboring under disadvantages which would bring discouragement were it not for the love of the science and the hope awakened anew as each experiment opens up the vista beyond, and they catch a glimpse of the possibilities to be attained by further attempts.

It is to this latter class that the "electrical quack" is the greatest scourge. Their means are limited, and each purchase of such worthless property means the curtailment of other purchases or other more or less valuable experiments.

My advice to the amateur is to purchase necessary supplies from reliable houses only, and to avoid the "wonderful primary battery" as a delusion and a snare.

Some Fallacies in Dynamo and Motor Design.

BY F. B. CROCKER.

In THE ELECTRICAL WORLD of Nov. 12, 1892, there appeared an article entitled, "Some Anomalies in Dynamo Design." Most of the points in that article are well taken, but some of them seem to be anomalies themselves. This latter fact and the general importance of the subject lead me to take the opportunity to call attention to several common mistakes of this kind.

The article referred to, ridicules the practice of making "a dynamo with a ponderous bedplate," and then mounting it "on two little slides." The statement is also made that "If the machine is designed to be used on foundation rails the bed plate might be omitted." This idea is in my opinion absolutely incorrect. If a machine is to be bolted down solidly to a foundation and is *not* to be mounted "on two little slides," then it does not need "a ponderous bedplate." If, on the other hand, the machine merely rests on rails, then it certainly does need a heavy base in order to prevent vibration or actual jumping up and down of the machine, due to the action of the belt, slide rails being naturally used with a belt. To take an extreme case: A machine would require a heavier base if it were to run while suspended by ropes, than if it were to be bolted to a solid foundation.

Almost any machine for stationary use should have a solid and reasonably heavy base if possible, and this is

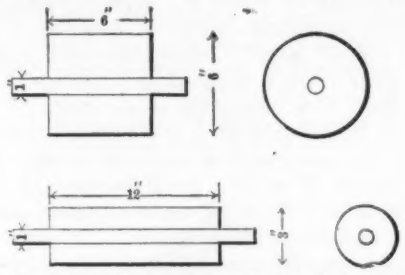


FIG. 1.—SHORT AND LONG DRUM ARMATURES.

particularly true if the machine merely rests or hangs and is not firmly bolted down. The article in question also ridicules that pet of the electrical engineer—the eyebolt. I consider the eyebolt to be a very useful feature of a dynamo. It would, of course, be possible to have eyebolts which are taken out after the machine is put in place, but why take the trouble to put in and take out (and very likely lose) eyebolts when nothing is gained by doing so? The eyebolt also tends to stop the common practice of lifting a dynamo by the armature, commutator or brush holders, which, of course, is almost certain to seriously injure the machine.

The so-called "dead wire" on a dynamo armature is another common fallacy. The idea is that the wire on the ends of the ordinary drum armature is useless, therefore the mistake has generally been made of designing drum armatures of great length and small diameter in order to reduce the proportion of the "dead wire." A simple example will show the error of this. Let us compare two drum armatures, the iron core of one being 12 inches long and three inches in diameter, and the core of the other being six inches long and six inches in diameter, as represented

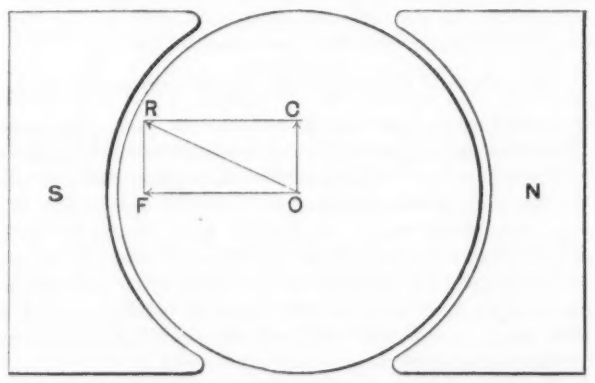


FIG. 2.—MAGNETIC PARALLELOGRAM OF FORCES.

in Fig. 1. The cross sections of these two cores are exactly equal, being $3 \times 12 = 36$ square inches for one and $6 \times 6 = 36$ for the other; therefore the total capacity for magnetic lines is the same. Assuming a 1-inch diameter hole through each of these cores for the shaft, then the net cross section is 24 square inches for the long drum and 30 for the shorter one, hence there is a 25 per cent. greater capacity for lines of force in the short drum. The minimum length of a turn of wire around the long drum is 30 inches, whereas it is only 24 inches for the short drum. This is a saving of 20 per cent. in wire in favor of the short drum.

The external surfaces of the two drums are exactly equal, being 113 square inches each. If, therefore, the same fraction of the surface is covered by the pole pieces, there will be the same magnetic reluctance and the same magnetic density in the air gap, with the same interferric space. As a matter of fact, however, it would be allowable to cover with the pole pieces a greater fraction of the armature surface in the case of the armature of larger diameter and still have a sufficient neutral space or distance between the pole piece horns. The number of turns of armature winding would be twice as great in the case of the shorter drum, because its circumference is twice as great; and the air gap, and therefore the depth of winding, are assumed to be the same.

The comparison is summed up in the following table:

Armature.	Short drum.	Long drum.
Dimensions.....	6 in. long × 6 in. diam.	12 in. long × 3 in. diam.
Total cross section.	36 sq. in.	36 sq. in.
Net " "	30 "	24 "
Length of a turn of wire.....	24 in.	30 in.
Relative number of turns of wire.....	2	1

It is proper to state that the volume and weight of the shorter drum would be twice that of the other, but this is offset by the increased number of turns of wire, leaving the other advantages all in favor of the shorter drum in spite of "its dead wire."

Another fallacy common even among the highest authorities on dynamo design is that of magnetic parallelogram of forces. For example, in Thompson's "Dynamo Electric Machinery" (fourth edition), on p. 80, the distortion of field and the angle of lead of the brushes of a dynamo due to armature reaction are treated by this magnetic parallelogram method. This consists in laying off, as in Fig. 2, a "line $O F$ to represent the magnetizing force due to the field magnets, and a line $O C$ at right angles to represent the magnetizing force due to the armature current. Then the diagonal $O R$ of the parallelogram will represent the direction of the resultant magnetization." Unfortunately this is not true either in theory or practice. Considered theoretically it is not true because the vertical component $O C$ or magnetizing force due to the armature is largely exerted through a medium—air—the permeability of which is 1, whereas the horizontal component, due to the field magnet, is largely exerted through a medium—iron—the permeability of which is ordinarily several hundred times as great. Furthermore the total magnetizing force due to the armature does not act to produce distortion of the field.

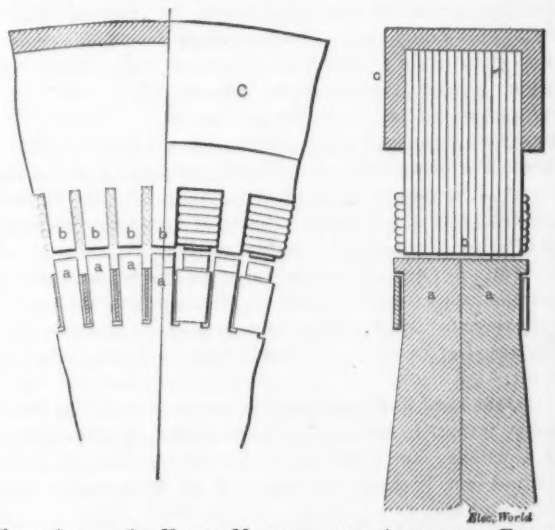
A correct method is to get the algebraic difference between the magnetomotive force of the armature and that of the field at any given point, and this divided by the reluctance gives the flux at that point. This may be expressed differentially and treated by means of the calculus.

As a practical disproof of the correctness of the magnetic paralellogram method, I would state that I have frequently tested dynamos in which the magnetizing force due to the armature was equal to or even greater than that of the field. That is to say, the ampère turns on the armature was greater than those on the field and yet the lead of brushes was only five or ten degrees, whereas it should have been over 45 degrees according to the magnetic parallelogram.

Ewing's High Frequency Alternator.

Prof. Ewing, whose tests of the Parsons steam turbine were published in our last issue, recently designed a high frequency alternator adapted to be driven by this high speed turbine. The complete apparatus, consisting of a steam turbine, alternator and a continuous current dynamo, all direct coupled and on the same base plate, was recently presented by Mr. Parsons to the Cambridge Laboratory.

The alternator has a speed of 1,200 revolutions per minute, and generates currents of 70 complete cycles per revolution, making 14,000 complete cycles per second; the output is about five ampères at 100 volts. The machine is intended for experimental purposes and investigation, among others

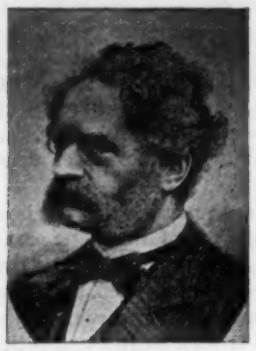


FIGS. 1 AND 2.—FIELD MAGNET AND ARMATURE POLES.

those of the physiological effects of high frequency alternating currents. The construction of the alternator will be seen in the accompanying diagrams, for which we are indebted to the London *Electrician*, in which Fig. 1 shows a part section and part elevation, while Fig. 2 shows a cross-section parallel to the shaft. $a\ a$ is the field magnet, which revolves, while the armature $b\ b$ is stationary; there are 140 poles in all. The magnets are made of two steel discs, $a\ a$, as shown in Fig. 2, in which radial cuts are made, thus forming the teeth, $a\ a\ a$. The armature is made of 60 plates of sheet iron, each about ten mils in thickness, held together by a cast iron ring, $c\ c\ c$; the teeth in these are likewise produced by cutting slots in the discs; the clearance or air gap is one thirty-second of an inch, and the depth of the teeth is three-eighths of an inch. The field magnets are wound with an insulated copper strip, as shown, which passes in a zigzag fashion between the teeth. The armature also is wound with a zigzag winding, only that fine wire is used instead of copper strip. The two steel discs forming the magnets are insulated from each other and act as terminals to lead the exciting current to and from the copper strip.

The Death of Dr. Werner Siemens.

Dr. Werner Siemens, the head of the famous firm of Siemens & Halske, died at Berlin on Tuesday of last week. He was so well known throughout the world as one of the leaders in the practical application of the science of electricity that the following biographical sketch, taken from "The Electrician Directory," will be of interest:



Werner Siemens.

Dr. Siemens joined the Prussian artillery in 1834, where his eminent talents soon attracted notice, and, having passed through the military schools, gained him the rank of lieutenant in 1837. While still holding this appointment in the army he applied himself with great zeal to the study of practical chemistry and physical sciences, and became the inventor of a process of electro-gilding, the differential governor, and the electric automatic recording telegraph, for all of which patents were granted him in Prussia. As member of a commission of the Prussian General Staff for the introduction of the electric telegraph system in place of the optical telegraph, he proposed, in 1847, the application of subterranean conductors, insulated by gutta-percha, and executed successfully experimental lines coated by gutta-percha, by means of a press invented by him for that purpose, which is being used even now in the manufacture of cables. With the help of these insulated wires he succeeded in laying, together with Professor Himly, the first submarine mines with electric ignition in the spring of 1848, for the protection of the harbor of Kiel from the Danish fleet. Still in the same year he carried out the first great telegraph line in Germany between Berlin and Frankfort-on-the-Main, and in the following year the subterranean line between Berlin and Cologne.

Dr. Siemens left government service in 1850, and devoted himself afterward entirely to scientific studies and private enterprises In 1847 he had already laid the foundation of the telegraph works carried on afterward by him under the firm of Siemens & Halske, in Berlin, the celebrated establishment which was destined to become, and at present is, one of the chief centres for the application of electricity to the industrial arts. Its world wide reputation acquired within a short time, led him to open branch works in London and St. Petersburg, which developed also soon into entirely independent large concerns, under the management of his younger brothers, William and Charles.

Dr. Siemens' personal achievements are to be found in the fields of science as well as in those of technical arts. His scientific merits enabled the University of Berlin to confer on him the dignity of Doctor of Philosophy, *honoris causâ*, in 1860, they opened likewise for him the doors of the Academy of Sciences in Berlin in 1874, and subsequently of many other academies and societies. Amongst his many and various achievements in matters relating to science and technical arts must be mentioned as particularly noteworthy the invention and application of the quicksilver unit (Siemens' unit), by means of which exact and comparative measurements became possible for the first time; further, that of the gutta-percha press already referred to above; that of the development of methods for testing underground and submarine cables and determining the position of faults in them; the invention of polarized relays of the so-called Siemens armature, and of the dynamo-electric machine, the principle of which he published first at the meeting of the Berlin Academy of Sciences on Jan. 17, 1867; the electric railway, and of numerous other inventions besides, as the pneumatic despatch tube system and the Siemens' alcoholimeter for registering the quantity of absolute alcohol contained in any alcoholic liquid passing through the instrument.

Dr. Siemens had been created a member of the Prussian order "Pour la Mérite." The late Emperor Frederic III. of Germany conferred upon him the patent of nobility. He had also become the recipient of many other distinctions and honors.

At the funeral of Dr. Siemens, Chancellor von Caprivi, Dr. von Boetticher, secretary of the Home Office; Herr von Berlepsch, Prussian Minister of Commerce; Dr. Hermann von Schelling, Prussian Minister of Justice; the municipal authorities and a large number of scientific men and artisans were present. The funeral was conducted with much pomp. The route to the cemetery was lined with thousands of people. Four thousand workmen from the Siemens factory followed the hearse. Among the floral offerings was a wreath from Thomas A. Edison, inscribed "To my friend."

Open and Closed Magnetic Circuit Transformers.

In a paper read by Profs. W. E. Ayrton and W. E. Sumpner before the British Association on Aug. 7, 1892, and reprinted in The Electrical World Oct. 8, p. 226, and Oct. 15, p. 243, the authors described a number of tests made to determine the losses occurring in transformers of the closed circuit type under ordinary working conditions. The tests actually published referred to four Mordey transformers of outputs varying from 1.5 to 4.5 kilowatts, but it was stated that numerous experiments had been made on a hedgehog transformer of four kilowatts output, and that these tests showed that neither at no load nor at full load was there any great difference between the power wasted in a hedgehog and in a Mordey type of transformer of the same output. The details of the tests on the hedgehog transformer were, however, reserved for later publication, as it seemed desirable to analyze more fully some of the results obtained.

Since that date they have repeated the tests, and by using a slight modification of the method before employed (see Fig. 1, p. 226, of The Electrical World, Oct. 8, 1892), have obtained very satisfactory results. The following is a description of their recent tests, published by them in the London *Electrician*.

As we indicated in the paper already mentioned, some of the peculiar results previously obtained with the Swinburne transformer were due to its large magnetizing current, which prevented the current, as read by the dynamometer, being any measure of the load on the transformers. Corrections had also to be applied owing to the fact that the transformers were working at somewhat different voltages.

The arrangement of the apparatus employed for the recent tests is shown in the figure. The thick coils of a three-kilowatt Mordey transformer *M*, and of a four-kilowatt hedgehog transformer *H*, were put in parallel on low-pressure mains, a Siemens dynamometer *S D* being so connected as to measure the current through the coils of *H*. A Ganz wattmeter *G W* measured the power supplied to the combination of *M* and *H*. A third transformer *T* had its primary on the mains, and its secondary in series with the fine coils of *M* and *H*, these latter coils being connected so that their voltages opposed each other. A Swinburne wattmeter *S W* measured the power given out by the secondary of *T*, and an Ayrton and Mather electrostatic voltmeter *V* was arranged to measure the voltage on the fine coil of either *H* or *M*. In all the tests the fine coil of *H* was adjusted to 2,000 volts, and the transformer *T* was so arranged that *H* transformed down. In some of the tests a reflecting dynamometer, measuring up to two ampères, was placed in the high-pressure circuit, in which case the dynamometer *S D* was dispensed with. The sum of the readings of the two wattmeters measured the total power wasted in *M* and *H*, and, as the losses in *M* were known from the previous tests for all frequencies, voltages and currents, those in *H* could be found.

In testing with electrical currents it is most necessary to insure that the currents in the leads do not affect the readings of the dynamometers and wattmeters employed. The only effectual way to do this is to twist together the two

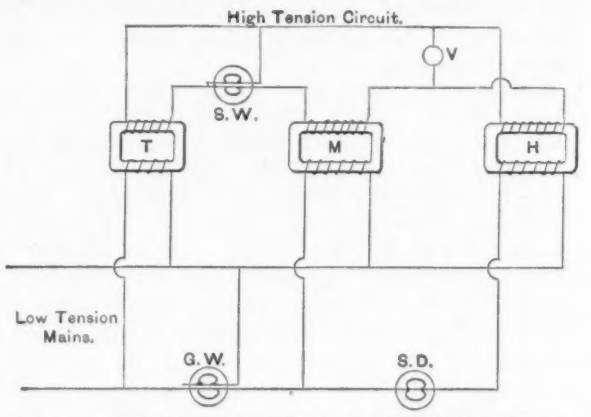


Diagram of Connections for Transformer Tests.

wires which lead up to and away from each instrument. Moreover, as suggested by us in connection with Mr. Swinburne's paper on "Electrical Measuring Instruments," read in April last at the Institution of Civil Engineers, it is of particular importance in testing *open* magnetic circuit transformers to take great care that the stray alternating field does not act directly on the measuring instruments. To make sure of this we have found it necessary to place the measuring instruments several yards away from the hedgehog transformer.

The following is a sample of tests made at a frequency of 100 ~, with the dynamometer in the fine wire circuit:

Volts in hedgehog transformer	2,000	2,000	2,000	2,000
Volts in Mordey transformer	2,000	1.960	1.950	1,880
Ampéres in fine wire circuit	0	1.32	1.53	1.84
Sum of watts read by two wattmeters	275.0	339.5	362.5	391.5
Watts lost in coils of Mordey transformer	0	40	54	78
Watts lost in iron of Mordey transformer	106 5	105.5	105.0	96.0
Watts lost in copper and iron of hedgehog transformer	168 5	194.5	203 5	217.5
Watts lost in copper of hedgehog transformer	0	28.2	39.5	55.0
Watts lost in iron of hedgehog transformer	168.5	166.3	164.0	159.5

For convenience of tabulating, the numbers under the head of copper losses do not include the constant part of the copper losses, viz., that due to the magnetizing currents, and this latter is included in the numbers under the head of iron losses. The watts lost in the iron of the Mordey transformer diminish as the load is increased, owing to the fact that the voltage at which it is worked diminishes as the current increases, the alteration being shown by the numbers in the second row of figures.

Shortly before these tests were made the Ganz wattmeter was tested to see whether it read correctly. The open circuit losses of *M* and *H* were tested separately, and were, respectively, 105 and 163 watts. The sum of the two losses was also tested and found 271, which is sufficiently near 268, the sum of 106 and 163, to show that the inductive nature of the load introduced no appreciable error in the wattmeter readings.

The losses occurring in coils of the hedgehog transformer were tested with both direct and alternating currents, and found to be 65 watts at 40 ampères.

Complete sets of experiments were made, not only at frequencies of 100 ~, but also at 150 ~ and 200 ~. It will be sufficient, however, to add a sample of the results at a frequency of 200 ~.

Volts on hedgehog transformer	2,000	2,000	2,000	2,000	2,000	2,000
Volts on Mordey transformer	2,000	1,820	1,775	1,695	1,645	1,600
Ampéres in thick wire circuit	0	19.2	20.35	24.10	25.6	28.1
Sum of watts read by two wattmeters	192	234	228.2	241.0	256.0	270.0
Total copper losses in watts	0	41.3	46.5	65	73.5	88 5
Total iron losses	192	192.7	181.7	176	182.5	181.5
Watts lost in iron of Mordey transformer	80	73	71	68	66	64
Watts lost in iron of hedgehog transformer	112	119.7	110.7	108	106.5	107.5

The open circuit losses at different frequencies were also separately determined and the mean of a large number of tests gave the following numbers for the hedgehog transformer:

160 watts at a frequency of 100 periods,
131 watts at a frequency of 150 periods,
117 watts at a frequency of 200 periods,

and these numbers were expressed as a fraction of the full load of 4,000 watts, give 4.0 per cent., 3.27 per cent. and 2.92 per cent. Whereas, as stated in the authors' British Association paper, the open circuit losses for a transformer of the Mordey type, expressed at a fraction of full load, were only 3.2 per cent., 2.8 per cent. and 2.36 per cent., at frequencies of 100, 120 and 160, and, of course, still less at a frequency of 200.

From the results given in this communication the authors obtain as the efficiencies of the hedgehog transformer at the full load of 4,000 watts, 94.38 per cent., 95.10 per cent. and 95.45 per cent., at frequencies of 100, 150 and 200 respectively.

NEW BOOKS.

The Engineer's Epitome. By N. J. Smith, of Hartford, Conn. 135 pp. Illus. Published by the Mason Regulator Company, Boston, Mass. Price 50c.

This little manual is the third publication in the Mason Regulator Engineering series. It consists of a collection of figures, facts and formulæ for engineers, brought together and arranged with explanatory matter by an engineer of 30 years experience. The ground covered will be seen from the titles of some of the most important chapters, which are as follows: Properties of Steam; Temperature and Vacuum; Volume, Weight and Velocity of Steam; Boilers; Tests of Moisture in Calorimeter; Chimneys; Horse Power of Engines; Slide Valves; Belts and Governors.

Induction Coils; a Practical Manual for Amateur Coil Makers. By G. E. Bonney. 101 ills., 231 pp. New York: Macmillan & Co., 1892. Price, $1.

According to the preface this book has been written to meet the wants of amateurs who desire a practical acquaintance with induction coils and their accessories and suitable batteries for their working. If the book meets the wants of this class it will prove to be extremely useful, for the inquiries we receive from week to week indicate that there are many amateur constructors who have often sought information of the kind which this book seeks to give. The author aims to give a general insight into the construction of ordinary spark coils, medical coils and batteries to be used in connection with them.

New Dynamo Tenders' Hand-Book. By F. B. Badt. 140 illustrations. 226 pp. Chicago: The Electrician Publishing Company. 1892. Price $1.

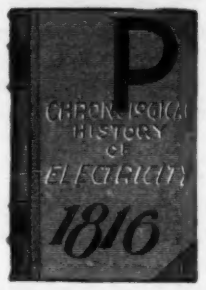
The widespread circulation which the author's first book on this subject has had makes it unnecessary to give detailed information regarding the present book. As its name indicates it is in every sense a new book, and not a mere reprint with slight revisions of the first edition. It contains much more complete information than the old one, with instructions and rules required by practical men, such as dynamo tenders, engineers, linemen and others, who wish to familiarize themselves with the general practice upon which depend the successful operation and maintenance of electric light and power installations.

Electric Traction on Railways and Tramways. By Anthony Reckenzaun. 422 pp., 213 ills. London: Biggs & Co., 1892. Price, $4.

According to the author's statement in the preface this book is the result of an endeavor "to summarize as concisely as possible the present state of electric traction, and to describe the various methods and constructive details which are to-day in use, or which have marked consecutive steps in the development of the art." As might be expected, the matter contained in the book is very largely derived from American sources, and the tests upon which the author has drawn for his results are those made upon roads in this country. It was the author's intention, doubtless, to furnish for the English reader a work which would hold in the English market a place similar to that already supplied here by Crosby and Bell's treatise. It is mainly a collection of descriptive matter, but which is here and there necessarily accompanied by comment or criticism, for which Mr. Reckenzaun's experience in railway work has eminently fitted him. The collected matter has usually been well edited and a great deal of matter condensed into a small space.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.



PHILIP (WILSON), English physician, publishes in the *Philosophical Transactions* a continuation of researches made by him to establish the relations existing between the phenomena of life and voltaic electricity. Noad gives [1] an account of some of the experiments made on animals to prove the analogy existing between the galvanic energy and the nervous influence, and he alludes also to the fact of asthma having been relieved by galvanism through Dr. Philip, whose treatment has received the endorsement of Dr. Clarke Abel, of Brighton.[2]

A. D. 1816.——The Rev. James Bremmer, of the Shetland Islands, is rewarded by the Society of Arts for his night telegraph, the operation of which consists in the alternate exhibition and concealment of a torch in a manner similar to that devised by Joachimus Fortius for Bishop Wilkins, as stated at A. D. 1641. This plan is said to have answered for 20 miles and upward and to have been successfully operated between the Copeland Island lighthouse and Port Patrick on the other side of the English Channel.

Particulars of the above named telegraph, as well as of the Rev. Mr. Bremmer's apparatus for day service, will be found in the *Trans. Soc. of Arts*, vol. xxxiv., pp. 313, 227. The day telegraph consisted of a framework, having two circular openings, in each of which was a semi-circular screen or shutter which, revolving upon an axis in the centre of the circle, was capable of assuming four different positions. This contrivance expressed an alphabet of 16 letters, by dividing the latter into four classes of four each, and making one screen or shutter express the class, while the other indicated the number of the letter in that class.

A. D. 1816.—— Sir Home Riggs Popham (1762-1820) British naval officer, who had been a rear-admiral in 1814, introduces his land semaphore which shows a great improvement upon all previous ones and at once supplants the Murray apparatus heretofore used by the English Admiralty (see A. D. 1795). It consists merely of two arms placed upon the same hollow hexagonal mast, and movable upon separate pivots, each of which can be made to assume six different positions, giving together 48 different signals. It is fully described and illustrated in vol. xxxiv. of the *Trans. of the Soc. of Arts*, and also appears in the "Telegraph" article, vol. ii., of the "Encycl. of Useful Arts," as well as at page 149, vol. xxiv., of the "Penny Encycl.," at pages 67, 68, vol. viii., of the (Arts and Sciences) "English Encycl." and in the "Telegraph" article by Sir John Barrow, one of the secretaries to the Admiralty, which appears in the Seventh "Britannica."

In this same year (1816), Sir Home Popham also introduced a ship semaphore, which latter, as well as other similar devices of his construction, is to be found in the several publications already mentioned.[3]

A. D. 1816.——Ronalds (Francis), English experimentalist 1788-1873)—F. R. S. 1844, knighted 1870—whose serious attention to the development of electrical science appears to date from his meeting with Mr. De Luc in 1814, constructs at Hammersmith his well known telegraph which is the type of all dial instruments and which presents for the first time the employment of two synchronous movements at the two stations. The latter is fully described and illustrated in the "Description of an Electrical Telegraph and of Some Other Electrical Apparatus," 8vo, 33 pages, which Mr. Ronalds published in pamphlet form, London, 1823, and which is said to be the first work published on electric telegraphy. Copious extracts from the latter are to be found at pages viii., xi. of the Ronalds catalogue, and at pages 129, 135-145, of Fahie's "History," the latter also containing several fine plates reproduced from the original work.

For his experimental line Ronalds "erected two strong frames of wood at a distance of 20 yards from each other, and each containing 19 horizontal bars; to each bar was attached 37 hooks, and to the hooks were applied as many silken cords, which supported a small iron wire (by these means well insulated), which (making its inflections at the points of support) composed in one continuous length a distance of rather more than eight miles." After making many experiments with this overhead line, he laid one underground as follows:

> A trench was dug in the garden 525 feet in length, and four feet deep. In this was laid a trough of wood two inches square, well lined on the inside and out with pitch, and within this trough thick glass tubes were placed, through which the wire ran.

His biographer, Mr. Frost, adds:

> In order to prevent the tubes from breaking by the variation of temperature, each length was laid a short distance from the next length, and the joint made with soft wax. The trough was then covered with pieces of wood, screwed upon it whilst the pitch was hot. They were also well covered with pitch, and the earth then thrown into the trench again.

Mr. Edward Highton, at page 40 of his work, the "Electric Telegraph," 1852, says:

> Ronalds employed an ordinary electric machine and the pith-ball electrometer in the following manner. He placed two clocks at two stations; these two clocks had upon the second hand arbor a dial with twenty letters on it; a screen was placed in front of each of these dials, and an orifice was cut in each screen, so that only one letter at a time could be seen on the revolving dial. The clocks were made to go isochronously; and as the dials moved round the same letter always appeared through the orifices of each of these screens. The pith-ball electrometers were hung in front of the dials. The attention of the observer was called through the agency of an inflammable air gun fired by an electric spark.

Realizing the value of his invention, Ronalds strove to bring it before the English government, but was met (Aug. 5, 1816), with much the same encouragement we have seen vouchsafed Sharpe (A. D. 1813), and Wedgwood (A. D. 1814), viz.: "Telegrams of any kind are now wholly unnecessary and no other than the one now in use will be adopted;" the latter was the semaphore line between London and Portsmouth, originally of the Chappe pattern and improved upon by Charles W. Pasley and Rear Admiral Popham.

Alluding to Mr. (afterward Sir) John Barrow's letter in a note at page 24 of his work Ronald says:

> . . . Should they again become necessary, however, perhaps electricity and electricians may be indulged by his Lordship and Mr. Barrow with an opportunity of proving what they are capable of in this way.

He was so disappointed that he not long after announced his "taking leave of a science which once afforded him a favorite source of amusement," and that he was "compelled to bid a cordial adieu to electricity." Fortunately for the scientific world, however, he afterward gave his attention again to electrical matters as is evidenced by many important papers contained in the publications noted below.

In Ronald's aforenamed work the phenomenon of retardation of signals in buried wires is clearly foreseen and described, although Zetzche endeavors to combat this assertion at p. 38 of his "Geschichte der Elektrischen Telegraphie," Berlin, 1867. Speaking of the apprehended

SIR FRANCIS RONALDS.

difficulty of keeping the wire charged with electricity, Ronalds suggests that when it is not at work "the machine be still kept in gentle motion to supply the loss of electricity by default of insulation; which default, perhaps, could not be avoided, because (be the atmosphere ever so dry, and the glass insulators ever so perfect) conductors are, I believe, robbed of their electricity by the same three processes by which Sir Humphry Davy and Mr. Leslie say that bodies are robbed of their sensible heat, *viz.*, by radiation, by conduction, and by the motion of the particles of air." He also gives descriptions of an improved electrical machine,[4] of a new method of electrical insulation and of some experiments on Vesuvius,[5] of a new electrograph for registering the charge of atmospheric electricity of a pendulum doubler[6] and of an attempt to apply Mr. De Luc's electric column to the measurement of time. His other contributions relative to the dry pile are to be found in the *Phil. Mag.*, vols. xliii., p. 414, and xlv., p. 466.[7]

A. D. 1816.——Porret (Robert) communicates to the *Annals of Philosophy* (vol. viii., p. 74) a paper "On Two Curious Galvanic Experiments" (Electrovection, Voltaic Endosmose, or Electro-chemical Filtration.)

He observed that when water was placed in a diaphragm apparatus, one side of which was connected with the positive and the other side with the negative electrode of the battery, that a considerable portion of the liquid was transferred from the positive toward the negative side of the arrangement. It has since been found that the same result occurs in a minor degree when saline solutions are electrolyzed, and, generally, the greater the resistance which the liquid offers to electrolysis the greater is the amount which is thus mechanically carried over. . . . It appears from the researches of Wiedemann,[8] which have been confirmed by those of Quincke, that the amount of liquid transferred, *cæteris paribus*, is proportioned to the strength or intensity of the current; that it is independent of the thickness of the diaphragm by which the two portions of liquid are separated; and that when different solutions are employed, the amount transferred in each case, by currents of equal intensity, is directly proportional to the specific resistance of the liquid. Miller, from whom the above is taken, says that this transfer has been minutely studied by Quincke, and gives an account of the latter's work extracted from the *Ann. de Chimie*, lxiii., 479. Brewster's allusion to Porret and Wiedemann (Eighth "Britannica," vol. viii., p. 630) is followed by the statement that Mr. Graham considers ordinary endosmose as produced by the electricity of chemical action.[9]

A. D. 1817.——Mr. Connolly makes known through an English and French pamphlet, entitled "An Essay on Universal Telegraphic Communication," the details of his portable telegraph.

As shown in the thirty-sixth volume of the *Transactions of the Society of Arts* and in the twenty-fourth volume of the "Penny Encyclopedia," his apparatus consists merely of three square boards painted with simple devices, like triangles, crescents, etc., the colors on the one side being the reverse of those on the other. Each of the six figures thus obtained is capable of producing four different distinct signals, making in all 24, by successively turning each side of the board downward. In experiments made at Chatham boards only 18 inches square were found to answer for a distance of two miles, with a telescope having a magnifying power of 25; and Mr. Connolly had also, it is said, exhibited these signals between Gros-nez and Sarque, a distance of 17 miles, with boards 12 feet square.

At pages 205 and 208 of the Society of Arts *Transactions*, vol. xxxv., will be found Mr. Connolly's system of telegraphing by means of flags in manner different from that of Lieut. Col. John Macdonald alluded to at Pasley A. D. 1808.

A. D. 1817.——In the "Encycl. Brit." article treating of the influence of magnetism on chemical action, it is said that Mr. Muschman, professor of chemistry in the University of Christiania, made experiments to ascertain the effect of the earth's magnetism on the precipitation of silver.

Desirous of explaining the chemical theory of the tree of Diana (*Arbor Dianæ*, first observed by Lemery), "he took a tube like a siphon and poured mercury into it, which accordingly occupied the lower part of the two branches; above the mercury he poured a strong solution of nitrate of silver. He then placed the two branches of the siphon so that the plane passing through them was in the magnetic meridian, and after standing a few seconds the silver began to precipitate itself with its natural lustre; but it accumulated itself particularly in the northern branch of the siphon, while that which was less copiously precipitated in the other branch had a less brilliant lustre, and was mixed with the mercurial salt deposited from the solution. M. Muschman and Prof. Hansteen repeated this experiment in an improved form with the very same result. The two Norwegian philosophers conclude, with some reason, that the magnetism of the earth had an influence on the precipitation of silver from a solution of its nitrate, and Mr. Muschman inferred from the experiment the identity of galvanism and magnetism.[10]

A. D. 1817.——Freycinet (Claude Louis Desaulses de), captain in the French navy, is sent in command of an expedition fitted out by the French government for the purpose of making scientific observations in a voyage round the world. The stations at which the experiments were made were the Island of Rawak (near the coast of Guinea), Guam (one of the Ladrones), the Isle of France, Mowi (one of the Sandwich Islands), Rio Janeiro, Port Jackson, Cape of Good Hope, Paris and the Falkland Islands, as described in his "Voyage Autour du Monde . . . ," Paris, 1842.

His observations on the diurnal variations of the needle, which confirm the investigations made by Lieut. Col. John Macdonald (A. D. 1808) are to be found at page 54, vol. xiv. of the Eighth "Britannica."[11]

A. D. 1817.——In vol. xlii., pp. 165, 166, of the *Transactions of the Society of Arts* will be found a record of the explanation which Mr. Westcott made of his magnetic guard for needle pointers before the Committee of Mechanics during the year 1817. This is said to consist of several "bar magnets smeared over with oil placed in a frame behind the grindstone."

A. D. 1818.——Bostock (John), English physician, F. R. S., lecturer at Guy's Hospital, publishes in London his "Account of the History and Present State of Galvanism," which is scarcely more than a compilation of works treating of that branch of science.

One of the passages is, however, worth quoting, for it reflects the opinion shared by many physicists of the

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[1] "Manual," pp. 341-344.

[2] *Journal of Science*, vol. ix. See also Faraday's "Experimental Researches," 1791 and note; "Abstract of Papers . . . *Phil. Trans.*, 1800-1830," vol. ii., for 1822, p. 156.

[3] Consult likewise the "Navy" article of the "Britannica" and pp. xii., xiii. of Ronald's Catalogue.

[4] Eighth "Britannica," vol. viii., p. 536; *Sci. Am. Supp.*, No. 647, p. 10,326; Noad's "Manual," p. 69.

[5] *Quarterly Jour. of Sci.*, vols. ii., p. 249; xiv., pp. 332-334.

[6] *Edinb. Phil. Jour.*, vol. ix., 1823, pp. 323-325.

[7] See "Biog. Mem. of Sir Francis Ronalds, F. R. S., by Alfred J. Frost" in Ronalds' Catalogue; "Mem of Dist. Men of Science," by William Walker; Ronalds' "Corres. and Memoir.," in 1848-49, to 1853, to April 17, 1855, to June 5, 1856, to Sept 2, 1862, and in 1866-70; Ronalds' "Walk Through . . . Exh. of 1855;" *Illustrated London News* of April 30, 1870; Eighth "Brittannica," vol. viii., pp. 622, 627, for Ronalds' improved electrometers and his telegraph; *Nature*, London, Nov. 23, 1871, vol. v., p. 59; *Journal of the Telegraph*, March 15, 1875, vol. viii., p. 82, reporting the inaugural address of Mr. Latimer Clark before the English Society of Tel. Engineers; *Comptes Rendus* for 1838, vol. vii., p. 593, etc.; *Sci. Am. Supp.*, No. 384, p. 6,127, No. 547, p. 8,735, and No. 659, p. 10,521, for his Telegraph; "Bombay Mag. Observatory," 1850; *Fortschrift des Phys.* vol. iii., p. 586, and Buys-Ballot "Meteor. Preisfrage," 1847, for Ronalds' apparatus to measure atmospheric electricity; *Phil. Mag.*, vols. xliv., p. 442; xlv., p. 261; xlvi., p. 203; and 3d S. vols. xxviii., for 1846, xxxi., p. 191; British As. Reports for 1845, 1846, and Reports concerning the Kew Observatory for 1845, 1850, 1852; *Phil. Trans.* for 1847, Moigno's *Cosmos*, vol. xiii.; L. Von Forster, "All Banzeitung," for 1848, p. 238; Noad's "Manual," pp. 184, 185, 748; Knight's "Mechanical Dictionary," vol. i., p. 708; Turnbull's "Electromagnetic Telegraph," p. 22; *Annals of Electricity*, vol. iii., p. 449; "English Encycl." (Arts and Sci.), vol. viii., pp. 71, 72; *Jour. Soc. Teleg. Eng.*, 1879, part 15, xxviii., vol. viii, first part, p. 361; Reply to Mr. W. F. Cooke's pamphlet, "The Elec. Teleg.: Was it Invented by Prof. Wheatstone?" London, 1855; Du Moncel, vol. iii.; "Telegraphic Tales," 1880, p. 42; J. D. Reid, "The Telegraph in America," 1887, p. 71; Ure's "Dict. of Art," etc., London, 1878, vol. ii. (Elect. Metal.), p. 230; T. P. Schaffner, "Tel. Man.," 1850, pp. 147-156; Silliman, "Principles of Physics," 1869, p. 617.

[8] *Pogg. Ann.*, vol. lxxxvii., p. 321.

[9] Graham, vol. ii., p. 266; De la Rive's "Electricity," chap. 4, pp. 424-433. See "Roy. Soc Cat. of Sci. Papers," vol. iv., pp. 387, 988; Wm. Henry, "Elem. of Exp. Chem.," 1823, vol. i., p. 178; C. Matteucci, "Traité des Phénom. Elect. Phys.," 1844, p. 262, for Porret and Becquerel; Sturgeon's "Sc. Researches," Bury, 1850, p. 544; Poggendorff, vol. ii., p. 503.

[10] Eighth "Britannica," vol. xiv., p. 42.

[11] See his "Voyage de Découvertes . . . 1800-1804 . . . " (F. Péron and Louis Freycinet), also his "Navigation et Géog. . . ," 1815; the note at page 158, vol. i., of Humboldt's "Cosmos," London 1849; *Phil. Mag.*, vol. lvii., p. 20.

time that the resources of the galvanic field were already well-nigh exhausted. It thus appears at page 102: "Although it may be somewhat hazardous to form predictions respecting the progress of science, I may remark that the impulse which was given in the first instance by Galvani's original experiments, was revived by Volta's discovery of the pile, and was carried to the highest pitch by Sir H. Davy's application of it to chemical decomposition, seems to have, in a great measure, subsided. It may be conjectured that we have carried the power of the instrument to the utmost extent of which it admits; and it does not appear that we are at present in the way of making any important additions to our knowledge of its effects, or of obtaining any new light upon the theory of its action."

He is also the author of "Outline of the History of the Galvanic Apparatus," "On the Theory of Galvanism" (*Nicholson's Journal* for 1802); "On the Hypothesis of Galvanism" (*Annals of Philosophy*, iii., 1814), and of other works upon different scientific subjects. Reference is made by Mr. William Leithead ("Electricity," London, 1837, chapter vi., pp. 296, 297) to Bostock's "Elementary System of Physiology," 1827, vol. ii., p. 413, etc., wherein is shown, among other results, that, contrary to the views of Dr. Philip, there is no necessary connection between "the nervous influence" and the action of the glands. At page 306 of Leithead appears another extract, from the third volume of Bostock, relative to the application of the electro-physiological theory in elucidating the phenomena of disease.[1§]

(To be continued.)

Experimental Studies of the Differences of Potential Generated Through Contact of Metals, Liquids and Dry Electrolytes.—IV.*

BY WALTER NEGBAUR, PH. D.

In general: In 1847 von Helmholtz† called attention to a dependence of the E. M. F. of galvanic cells upon the algebraic sum of the caloric characteristics (quantities of heat, evolved by combination and decomposition) which correspond to the chemical changes in the element. Later Sir W. Thomson‡ from the principle of the conservation of energy showed the E. M. F. to depend upon the product of the mechanical equivalent of heat, time difference of the caloric characteristics of the compounds. This theory was for a long time assumed to be a general solution of the problem, while experiments showed the theory to be in complete accordance with practice. Later, in the works of different investigators, most notably F. Braun,§ very great deviations between theory and practice were demonstrated in a very thorough manner.

After Faraday, in whatever manner the single falls of potential arise, the theory of Sir W. Thomson will always be justified, that the E. M. F. is to be considered as a function of the chemical actions in the element. However, in most of the elements, only a portion of the chemical energy is transformed into electrical; the rest remains as the heat of secondary processes in the element. If one considers, also, the heat which is generated when the electric charge crosses from one metal to the solution, and vice versa, the so-called local generation of heat, which, according to Von Helmholtz is proportional to the absolute temperature, it is seen that in each special case there is a different division of the total energy. Therefore theoretical values can be compared with those experimentally obtained only in combinations in which the one or the other of the parts in which the total energy divides is equal to zero. For those reversible elements which give the efficiency, 1, such as the Daniell element, Von Helmholtz has concluded: As the local generation of heat is equal to zero, such elements must be independent of the temperature. This conclusion has been confirmed.

My observations show that, moreover, some non-reversible elements must be independent of the temperature, since they conduct without polarization, and give the efficiency 1. For example, the mean value of the observed E. M. F. of the element $Pb \mid PbI_2 \mid Zn = 0.201$ volt. On the basis of the values of the caloric characteristics given later, it is calculated to be 0.202 volt, and according to the value given above it is not polarizable.

In the following I will, under *A* 1, compare the E. M. F. obtained from Thomson's theory with the experimental for a series of reversible elements in which no secondary processes appeared.

A. Reversible Elements.

1. Calculation according to Thomson: The caloric characteristics of the element: $M_1 \mid M_1 R \mid M_2 R \mid M_2$ are: $+ (M_1, M_1) - (M_1, R) + (M_2, R) - (M_2, R) + (M_2 R) - M_2, M_2)$.

The heats which correspond to the liberation of the metal M_1 and the solution of the metal M_2, are unknown (compare the last section of this article). For the solution of the problem, we place in the customary way $(M, M_1) - (M_2, M_2) = 0$. Then the equation for the E. M. F. of the cell, reads:

$$C\,[(M_2, R) - (M_1, R)] = E,$$ when C denotes the constant 43×10^{-6}. The following caloric characteristics, derived by J. Thomson, are used for the calculation:

Ag Cl	29.380	Hg Cl_2	63.160
Ag Br	22.700	Hg Br_2	50.550
Ag I	13.800	Hg I_2	34.310
Pb Cl_2	82 770	Hg_2 Cl_2	82.550
Pb Br_2	64 450	Hg_2 Br_2	68.290
Pb I_2	39.800	Hg_2I_2	48.440
Zn I_2	49.230		

Table of the observed and calculated E. M. Fs.:

	Cells.	E. M. Fs. Calculated.	Observed.
a	Ag | Ag Cl | Pb Cl_2 | Pb:	+ 0.516	+ 0.517
	Ag | Ag Br | Pb Br_2 | Pb:	+ 0.410	+ 0.418
	Ag | Ag I | Pb I_2 | Pb:	+ 0.262	+ 0.214
b	Hg | Hg Cl_2 | Ag Cl | Ag:	− 0.095	+ 0.075
	Hg | Hg Br_2 | Ag Br | Ag:	− 0.110	+ 0.085
	Hg | Hg I_2 | Ag I | Ag:	− 0.144	+ 0.170
c	Hg | Hg_2 Cl_2 | Ag Cl | Ag:	− 0.512	+ 0 002
	Hg | Hg_2 Br_2 | Ag Br | Ag:	− 0.492	+ 0.008
	Hg | Hg_2 I_2 | Ag I | Ag:	− 0.448	+ 0.111
d	Hg | Hg Cl_2 | Pb Cl_2 | Pb:	+ 0.422	+ 0.510
	Hg | Hg Br_2 | Pb Br_2 | Pb:	+ 0.298	+ 0.526
	Hg | Hg I_2 | Pb I_2 | Pb:	+ 0.118	+ 0.317
e	Hg | Hg_2 Cl_2 | Pb Cl_2 | Pb:	+ 0.0047	+ 0.001
	Hg | Hg_2 Br_2 | Pb Br_2 | Pb:	− 0.082	+ 0.305
	Hg | Hg_2 I_2 | Pb I_2 | Pb:	− 0.186	+ 0.600

A comparison of the observed and calculated E. M. F's gives the result that only three cells

1. Ag \| Ag Cl \| Pb Cl_2 \| Pb,
2. Ag \| Ag Br \| Pb Br_2 \| Pb
3. Ag \| Ag I \| Pb I_2 \| Pb,

have the efficiency 1. In this the total chemical energy is changed into electrical, and they are (theoretically) independent of the temperature. All others give greater or less differences of potential than if reckoned in the customary manner, and therefore confirm F. Braun's results.

2. Electro-chemical series: *While Thomson's theory pays no attention to the metal of the positive electrode, in all the combinations investigated the direction of the current was determined by the electrodes.* The metals used can be arranged in a series. When between two of them one or more solid salts are interposed, no matter in what modifications, each preceding metal is positive to all that follow it, and negative to all that precede it.

This series holds good for fluid eletrolytes down to silver, which, in our case, is negative toward copper. (Reversed with fluids.) The list reads, therefore: Platinum-Mercury-Copper-Silver-Lead-Zinc. *Dry electrolytes, however, do not follow the law of electro-chemical series* (equivalent solutions do this). If we interpose between the electrolytes of the cells:

Ag | Ag Br | Pb Br_2 | Pb : E.M.F. = 0.418 volt.
Ag | Ag I | Pb I_2 | Pb : E.M.F. = 0.214 "

salts with the acid radicals, so that the cells remain reversible, such new combinations give different E. M. Fs.:

Ag | Ag Br | Hg Br_2 | Pb Br_2 | Pb : E.M.F. = 0.518 volt.
Ag | Ag I | Hg I_2 | Pb I_2 | Pb : E.M.F. = 0.378 "

The observed values of these cells are very accurate. According to Thomson's theory the electrolytes should obey the law of electro-chemical series, for the heats which accompany the formation and decomposition of the interposed salts disappear from the equation.

(B). Non-reversible Cells.

In general: While the E. M. Fs. of the constant cells are independent of the time in the case of the inconstant cells the E. M. F. alters slowly with the time and usually decreases. It increased in only a few cases. The cause of this alteration of the E. M. F. is the formation of intermediate layers, which takes place with varying rapidity according to the kind of cell. The investigations of Oberbeck and Edler show that with the presence of a solvent the formation of the layers takes place so rapidly that it is usually impossible to measure the original value of the E. M. F. of two metals in a dissolved electrolyte. They came to the following conclusion: "The inconstant cells may be compared to the corresponding constant cells by the assumption of molecular layers and of solutions of the metal electrodes. The latter are to be considered as dilute solutions." *In contrast to this it is possible with most of the dry elements to obtain the true value of the difference of potential of two metals in an electrolyte*, but so much accuracy cannot be obtained for the original value of the E. M. F. as in the observations of reversible cells.

If we accelerate the formation of the intermediate layers by sending a current from an external source through the element, we obtain the following result: A current flowing through in such a direction as to charge the element, which is, therefore, directed in opposition to the element's own E. M. F., increases the E. M. F. of the cell considerably. A current in the opposite direction could in almost all cases decrease the E. M. F. to zero.

If we examine more carefully the true differences of potential of two metals in an electrolyte we observe certain regularities.

1. In the first line the E. M. F. of inconstant cells is dependent upon the position of the electrodes in the electrochemical series. The combinations Pt | MR | Zn give, accordingly, always the greatest, and the combinations Cu | MR | Ag always the smallest E. M. Fs.

2. Influence of acid radicals: If any two of the metals M_1, M_2 and M_3 are brought into contact with the electrolyte M_4 R, and if no secondary processes appear the following equation for the differences of potential obtains:

$$M_1 \mid M_4 R \mid M_2 + M_2 \mid M_4 R \mid M_2 = M_1 \mid M_4 R \mid M_2.$$

The values of the two members of this equation may be determined experimentally. From the previously given observations, I arrange here a table which is sufficient to prove this equation, for which, therefore, the assumption is justified that in these combinations no secondary processes appear:

1.	Pt | Pb I_2 |	(amorph)	Zn	E. M. F. = 0.735 Volt
2.	Pt | Pb I_2 |	"	Ag	" = 0.418 "
3.	Pt | Pb I_2 |	"	Cu	" = 0.366 "
4.	Pt | Pb I_2 |	"	Pb	" = 0.589 "
5.	Cu | Pb I_2 |	"	Ag	" = 0.093 "
6.	Cu | Pb I_2 |	"	Pb	" = 0.215 "
7.	Cu | Pb I_2 |	"	Zn	" = 0.460 "
8.	Ag | Pb I_2 |	"	Pb	" = 0.165 "
9.	Ag | Pb I_2 |	"	Zn	" = 0.346 "
10.	Pb | Pb I_2 |	"	Zn	" = 0.202 "

For example:

$Pt \mid Pb I_2 \mid Ag + Ag \mid Pb I_2 \mid Pb + Pb - Pb I_2 \mid Zn = Pt \mid Pb I_2 \mid Zn$

or numerically:

$$0.418 + 0.165 + 0.202 \text{ (sum, } = 0.785) = 0.735.$$

From the relation confirmed by measurement

$$M_1 \mid M_4 R \mid M_2 + M_2 \mid M_4 R \mid M_2 = M_1 \mid M_4 R \mid M_2$$

an interesting thermo-chemical result can be deducted. If we write down the total caloric characteristics which correspond to the processes contained in the above equation we have:

$$+ (M_4, M_4) - (M_4, R) + (M_2, R) - (M_2, M_2) + (M_4, M_4) - (M_4, R) + (M_2, R) - (M_2, M_2) = (M_4, M_4) - (M_4, R) + (M_2, R) - (M_2, M_2) \quad \text{or}$$

$$(M_2, R) - (M_4, R) = (M_2, M_2) - (M_4, M_4).$$

If we do the same for an analogous case in which the radical R^1 is substituted for the radical R, we have:

$$M_1 \mid M_4 R^1 \mid M_2 + M_2 \mid M_4 R^1 \mid M_2 = M_1 \mid M_4 R^1 \mid M_2$$

and if we then compare the resulting thermo-chemical equations we have:

$$(M_2, R) - (M_4, R) = (M_2, R^1) - (M_4, R^1),$$

that is to say, the difference of quantities of heat, which are necessary in order to separate a radical R from a metal M_2 and from a metal M_4 is just as great as the corresponding difference that is necessary in order to separate another radical R^1 from the same metals.

The result is in complete agreement with the law stated by E. Wiedemann* at the conclusion of an example: "The difference of the work which must be expended in order to separate chlorine from calcium and bromine from calcium is just as great as the corresponding difference of work with hydrogen compounds."

(Concluded.)

Commercial Electrolysis.—III.†

BY EMILE ANDREOLI.

WHITE LEAD.

"The improvement of the manufacture of white lead deserves the most careful attention," suggests Mr. Swinburne. "The Dutch process is unhealthy, costly and barbarous."

Electro-chemists have not waited for this warning to manufacture white lead by electricity, and to quote only one process, the electrolytic production of white lead has been in practical operation for two or three years in America by Turner Bottome.

GOLD AND SILVER.

The electro separation of gold and silver from their ores by means of chlorine or other solvent is not in such a backward state as Mr. Swinburne is inclined to make us believe; it is, perhaps, only a question of time to see it adopted in all the mining districts where sulphuric acid costs something like one shilling per pound, and the other agents for chemically making chlorine are proportionally expensive. En passant, I will say that Mr. Swinburne is not quite right when he criticises Mr. Crookes, who uses an alternating current for extracting gold. "Unless the current density of the electrolyte is somewhat fabulous," says he, "there can be no current in the small particles of gold." Mr. Swinburne forgets that Mr. Crookes has for object the treatment of refractory ores, and that sulphuretted ores are semi-conductive; and that the pulverized pyrites, agitated in a very weak salt solution, constitute a fairly good electrolyte.

As regards his suggestion of "replacing Mr. Crookes' sodium amalgam by making the mercury itself the cathode," this has already been applied to the metallurgy of gold. Since the last five years the electric amalgamators are all based on the use of a mercury cathode, and the one which is most known in this country is the B. Molloy apparatus.

Mr. Swinburne seems, however, to believe implicitly in the electrolytic recovery of gold, and to be afraid of seeing gold become a drug like brass or a base metal, as his last sentence, which was no doubt inspired by an economist, runs: "All improved processes for obtaining precious metals merely enrich some at the expense of others, and reduce the value of the metals. Obtaining gold more easily would be no good to the community unless it became cheap enough to be used commercially."

ELECTRIC FURNACE.

"Properly speaking, this does not come within the scope of this paper," says Mr. Swinburne, "or there is no reason to suppose that *electrolysis has anything to do with the reduction of the oxides*."

If so, why does he talk digressively about it in his paper on the "Problems of Commercial Electrolysis?"

The same can be said of his comments on the electrical manufacture of phosphorus by the Reademan, Parker and Robinson process which he describes, although there is no more electrolysis in it than in the production of ozone by silent discharges.

CONCLUSION.

One would expect to find in the conclusion of this paper.

[1§] See Poggendorff, vol. i., pp. 249, 250; Leithead, "Electricity . . .," pp. 296, 297, 306; *Nicholson's Journal*, vols. ii., p. 296, and iii., p. 3; Figuier, "Expos. et Histoire," 1857, vol. iv., p. 425; Gilbert, vol. xii., p. 476.

* Based upon papers published in *Wiedmann's Annalen*, 1891 and 1892. For the first, second and third sections of this article see THE ELECTRICAL WORLD of Nov. 24 and Dec. 3 and 10, 1892.

†H. von Helmholtz, Wissenschaftl. Abh. 1, p. 50, 1882.

‡W. Thomson, *Phil. Mag.* (4). 2, p. 429 a. 551, 1851.

§F. Braun, Wied. Ann., 5, p. 182, 1878, 16, p. 561, 1882; 17, p. 593, 1882.

*A. Oberbeck u. J. Edler, Wied. Ann. 42, p. 209, 1891.

*, E. Wiedemann, Sitzgaber. d. Physik.-med. Societät. Erlangen 9, Februar 1891

† From the *Electrical Review* (London). For the first and second sections see THE ELECTRICAL WORLD of Nov. 26 and Dec. 10, 1892.

which I have briefly reviewed chapter by chapter, the essence, the summing up of the case of commercial electrolysis, but I must confess that Mr. Swinburne does not conclude anything at all.

There was no demand for such a superficial paper as has been given to the Institution of Electrical Engineers for the discussion of these Problems of Commercial Electrolysis. A scientific society or an academy is not an Areopagus of judges who may solve such or such commercial problems or difficulties, or declare that it is impossible to overcome them. Let Mr. Swinburne solve one of them, and he will be welcome when he explains how it was done "commercially," and how he successfully overcame all obstacles; but as long as he has not done so, we hardly see what ground he has for asking the Institution of Electrical Engineers to discuss so widely the present known field of electrolysis.

Where is the electrician who would discuss with him so decisively the Problems of Applied Electro-chemistry? The rôle of prophet is a dangerous one; on the one hand it would be unfair to condemn the work of the pioneers of the electrolytic industry because they did not reach perfection at once in applying commercially electrolysis to different industries; on the other, if in the Institution of Electrical Engineers there are members who know that they can solve the problem of, for instance, the production of chlorine and caustic soda, or the economical and rapid electro-separation of metals from their ores, or have found a good unattackable anode, I am positive that they will keep their ideas for themselves, and try to make, if not a "fortune," to use Mr. Swinburne's favorite expression, at least money, out of their discovery.

We live in a time of inventions and patents, and the electrician who would facilitate the work of his colleagues and

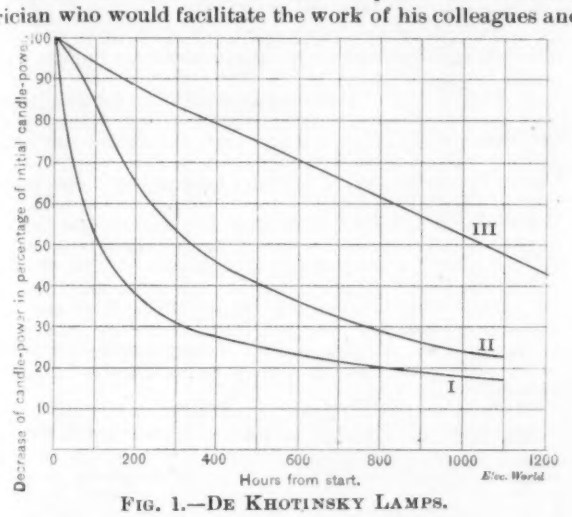


FIG. 1.—DE KHOTINSKY LAMPS.

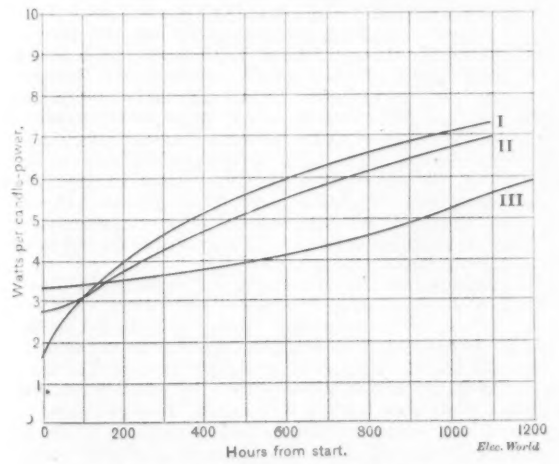


FIG. 2.—DE KHOTINSKY LAMPS.

competitors, and prepare the way to others by giving publicly at present the explanations wanted for the discussion of the "Problems of Commercial Electrolysis," would be considered very unwise.

Mr. Swinburne has touched almost all the main subjects which are in the province of electrolysis, but this paper is not worthy of him. He has not said anything new; he has not suggested any new direction in the field of electrochemistry, and he has not laid down any problem at all which a scientific society might "well spend its time" in discussing.

It now remains with me to ask the readers to be indulgent for my faulty English, and Mr. Swinburne to accept my criticism in the spirit in which it was written. Would he have treated me more tenderly if I had attempted to write a paper on the "Problems of Commercial Transformers?"

Life and Efficiency Tests of Incandescent Lamps.*

BY CLARENCE P. FELDMANN.

It is a well known fact that in the course of its life a glow lamp slowly decreases in candle power and efficiency, the latter being taken in its proper meaning, *i. e.*, candle-power watts. The object I had in view in undertaking this test was to determine the character of this decrease, especially for the so-called "low watt" incandescent lamps. For that purpose from three to ten lamps of each make were taken, their candle power and energy consumption determined at the normal working pressure of 72 volts, and they were then run at the laboratory of the Cologne central station, measurements being repeated every 50 and in the beginning every 25 hours.

In this way I tested 106 lamps of 21 different makes. I will first refer to the results obtained with the De Khotinsky lamps, as they best show the characteristic features of well made "low watt" lamps. There were in all 17 lamps, labelled 72 volts and 16 c. p., and some, in addition, 2½ watt (per candle). The energy was measured with a Ganz wattmeter, and the candle power with a Bunsen photometer, using the amyl acetate candle as unit. With respect to their initial efficiency, using the term in its ordinary significance, they were divided into three groups.

Group I. lamps giving 20.9 candles and taking 1.72 watts per candle.
II. " " 16.66 " " 2.76 " "
III. " " 16.0 " " 3.32 " "

The curves I., II. and III., in Figs. 1 and 2, show the decrease in candle power and the increase in watts per candle for groups I., II. and III.

TABLE I.

Group I.	*Group II.*
2 lamps were broken after 16 hrs.	1 lamp was broken after 110 hrs.
1 lamp was " " 45 "	1 " " " 212 "
1 " " " 230 "	1 " " " 246 "
1 " " " 176 "	1 " " " 281 "
1 " " " 246 "	1 " " " 400 "
1 " " " 302 "	1 " " " 1,080 "
1 " " " 370 "	*Group III.*
1 " " " 1,130 "	1 lamp was broken after 370 hrs
	2 lamps lived still after 1,500 hrs.

We see, therefore, that even lamps of low initial energy consumption may reach a high number of burning hours, but that towards the end of their life they have lost so

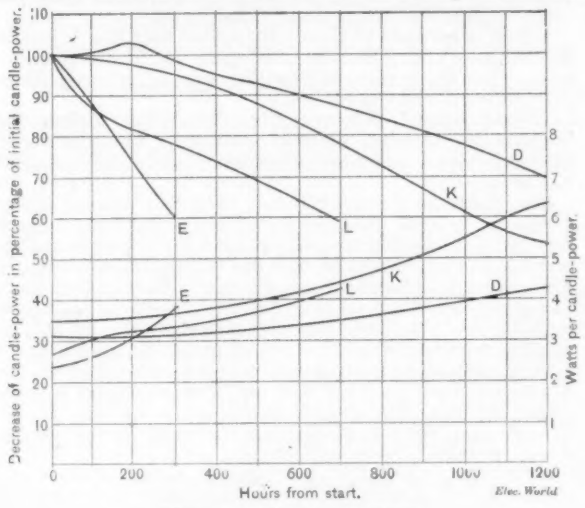


FIG. 3.—VENLOO LAMPS.

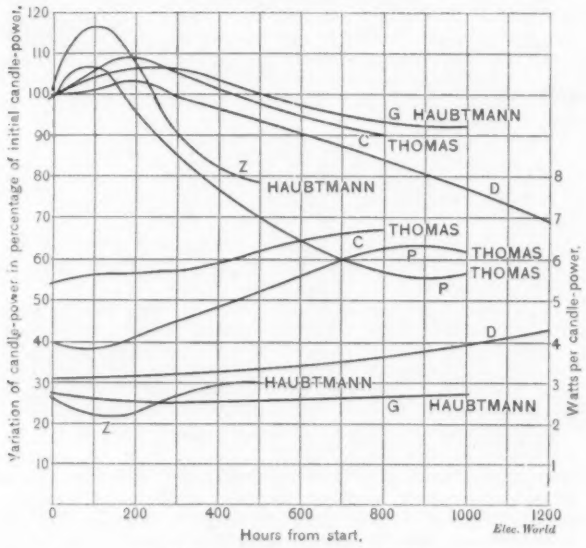


FIG. 4.—VARIOUS LAMPS.

much of their candle-power that it is practically impossible to run them out. Practice requires a certain minimum amount of candle power, say 50 per cent. of the initial candle power, and this limit must be taken as a measure for the *practically useful life* of the lamps. The life, defined in this way, was:

About 110 hours for the lamps of group I.
" 325 " " " " II.
" 1,050 " " " " III.

But the lamps of group III. are better than the other ones in other respects. The curves of Fig. 2 show that after 130 and 170 hours respectively they reach equal efficiency with those of groups I. and II. respectively, and that for a higher number of hours they work much more economically than the latter.

These properties are common to all well-made lamps, not only to those of De Khotinsky. I shall, however, not give all the curves obtained, but will only mention (Table II.) those of the Venloo lamps manufactured by Messrs. Gossens & Pope, because they show some characteristic features.

Table II. and Fig. 3 both show that the "low watt" lamps of this manufacture are better than the De Khotinsky lamps with respect to constancy of candle power, but worse with respect to the durability of the filaments. This is especially shown by the lamps of group E, of which

3 lamps were broken after 23 hrs.	1 lamp was broken after 108 hrs.
1 lamp was " " 48 "	1 " " " 112 "
1 " " " 76 "	1 " " " 163 "
1 " " " 63 "	1 " " " 320 "
1 " " " 90 "	

The single lamp, group D, shows an increase of candle power a few hundred hours after the start. A similar phenomenon was observed by M. Ch. Haubtmann, who found for a 16-c. p. Gérard lamp 6.5 per cent. increase after 250 hours, and for a 10-c. p. Zürich lamp (manufactured by Mr. Stearn) 17 per cent. increase after 100 hours, and by Prof. Thomas and Messrs. Martin and Hassler, who found for the lamps marked *C*, *D* and *P* an increase of 9, 1 and 7 per cent. Fig. 4 contains the characteristic curves for all these lamps.

TABLE II.—TEST OF VENLOO LAMPS.

Decrease of candle power.					Increase of watts per candle.				
Hours from start.	E.	L.	D.	K.	Hours from start.	E.	L.	D.	K.
	%	%	%	%		%	%	%	%
0	100	100	100	100	0	2.36	2.75	3.1	3.56
100	87.7	86.4	101	99	100	2.60	3.1	3.1	3.54
200	73 0	82.0	103	98	200	3.1	3.22	3.1	3.6
300	60.3	78.0	98	95.5	300	3.8	3.36	3.2	3.6
400		73.7	95.5	91.8	400		3.50	3.2	3.8
500		68	93.4	87.3	500		3.73	3.3	4.0
600		63.7	90.7	82.2	6 0		3.93	3.4	4.2
700		59	87.0	76.7	700		4.20	3.5	4.5
800			84.0	72.3	800			3.6	4.73
900			80.5	66.7	900			3.8	5.08
1000			76.8	61.2	1000			3 9	5.55
1100			73.0	56.7	1100			4.1	5 93
1200			69.7	53.5	1200			4 22	6.3

Taking mean value of all these tests which Thomas, Martin and Hassler, and afterward Haubtmann made, together with the results of my own measurements, I have calculated Table III., which contains mean values for more than 500 lamps, taken from 28 different factories, and representing 49 different types.

The values given in Table III. are plotted in Figs. 5 and 6. It may seem strange that the lamp with the highest initial consumption per candle power is, with respect to constancy of light, worse than that with four watts per candle power; but this irregularity may be due to the fact that these 4.5 watt lamps, which were all of

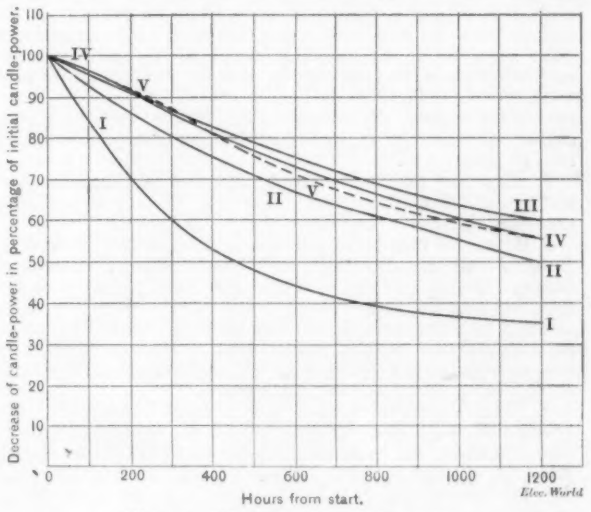


FIG. 5.—MODERN GLOW LAMPS.

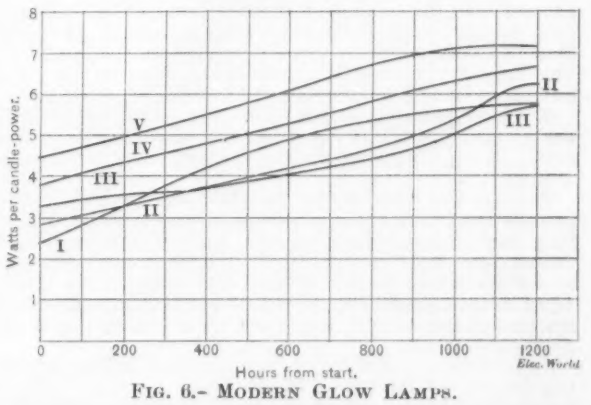


FIG. 6.—MODERN GLOW LAMPS.

TABLE III.—AVERAGE CANDLE POWER AND EFFICIENCY OF MODERN GLOW LAMPS AT DIFFERENT PERIODS OF THEIR LIVES.

	Initial Consumption.									
Hours after start.	2.0—2.5 watts per c. p. I.		2.5—3.0 watts per c. p. II.		3.0—3.5 watts per c. p. III.		3.5—4.0 watts per c. p. IV.		More than 4.0 watts per c. p V.	
	C. p. in per cent.	Watts per c. p.	C. p. in per cent.	Watts per c. p.	C. p. in per cent.	Watts per c. p.	C. p. in per cent.	Watts per. c. p.	C. p. in per cent.	Watts per c. p.
0	100	2 4	100	2.9	100	3.3	100	3.8	100	4.5
100	84	2.8	93	3.0	95	3.4	96	4.1	96	4 7
200	70	3.3	85	3.3	91	3.5	91	4.3	92	4.9
300	59	3.7	81	3 5	88	3.6	86	4 5	87	5.2
400	53	4.2	76	3.8	84	3 7	81	4.7	82	5.4
500	48	4.6	71	4.0	79	3.9	77	5.0	75	5 8
600	45	4.8	67	4.2	76	4.1	73	5.3	72	6.1
700	41	5.2	64	4 4	72	4.2	69	5.6	68	6 4
800	39	5.3	62	4.7	69	4.4	66	5.9	65	6.8
900	38	5.5	59	5.0	67	4.7	63	6.1	62	6 9
1,000	37	5.7	56	5.3	64	5.0	60	6 3	60	7.0
1,100	36	5.7	53	6.0	62	5.4	58	6.5	58	7.1
1,200	35	5.8	50	6.3	59	5 6	56	6.7	56	7.1

American manufacture, are somewhat worse than good modern lamps ought to be. What I want to emphasize, however, is that these Figs. 5 and 6 evidently show the 3.5 watt lamps (curve III.) to be the best among the modern ones, a fact which has been felt instinctively by many, but which, to my knowledge, had not yet been ascertained by exact measurements. Indirectly, these measurements, which were made with an alternating current of 50 ~ per second, prove the results of Profs. Ayrton and Perry's tests, which showed that there existed no difference in the efficiency of incandescent lamps fed with continuous or alternating current.

*From *The Electrician* (London).

The Edison Lamp Patent Suit.

The case of the Edison Electric Light Company and Edison General Electric Company vs. the Sawyer-Man Company was argued last week before Judges Wallace, Lacombe and Shipman, of the United States Circuit Court of Appeals for the Second Circuit. This is an appeal taken by the defendant from an order of the Circuit Court entered Nov. 19, 1892, enjoining the defendant from infringing United States patent No. 223,898, granted to Thomas A. Edison, Jan. 27, 1880, for an electric lamp.

The history of this important case is now well known. The patent in suit was before this court in the case of the Edison Electric Light Company vs. The United States Electric Lighting Company, in which a decision was handed down Oct. 4, 1892, affirming the decision of Judge Wallace in the lower court, adjudging the second claim of the patent to be valid and to be infringed. The following chronological statement of important events in the litigation may be of interest:

1880, Jan. 27, patent No. 223,898, now in suit, issued.
1880, November, United States Company commenced manufacture and sale of lamps in question.
1882, September, defendant's predecessor, the Consolidated Electric Light Company, commenced manufacture and sale of lamps in question.
1884, Nov. 17, original term of Canadian patent to Edison expired.
1885, May, suits against the United States Company and the Consolidated Company commenced by Edison Company.
1885, July, pleas filed in the above suits setting up the expiration of Canadian patent.
1887, Feb. 28, plea in United States case brought to argument.
1887, May, decision rendered sustaining plea.
1889, January, *Bate against Hammond* decided.
1889, February, plea withdrawn and answer filed in the United States case.
1891, July 14, United States case decided in favor of the complainant by Judge Wallace.
1892, April, complainants enter into combination with the Thomson-Houston Electric Company and its allied interests under the name of "General Electric Company."
1892, Oct. 4, Judge Wallace's decision in favor of the complainant affirmed by the Circuit Court of Appeals.
1892, Nov. 19, injunction order appealed from entered.

The defendant—the Sawyer-Man company—relies upon the following assignment of errors.

1. That the court did not refuse the said injunction on the ground that the complainant and their predecessors in interest have been guilty of gross laches in these their rights under the patent in suit, that by reason of such laches and as a direct result thereof large investments have been made by manufacturers of dynamo machines and other electrical apparatus, and by purchasers of plants who are dependent upon the defendant's factory for the necessary supply of incandescent lamps, and who would suffer irreparable injury if said injunction were granted and in force.

2. That the court did not refuse the said injunction on the ground that the complainants intend to make an unconscionable and inequitable use of the same.

3. That the court did not refuse the said preliminary injunction on the ground that the complainants have entered into an illegal and inequitable combination with various corporations in restraint of trade and commerce in and among the several States, and are seeking said injunction in furtherance of the purpose of said combination, and are therefore not entitled to the assistance of a court of equity in carrying out such purpose.

4. That the court did not refuse said injunction on the ground that it is sought in aid of an unlawful combination between the complainants and the Thomson-Houston Electric Company and various other incorporations for the prevention of competition and for the creation of a monopoly.

5. That the court did not refuse the said injunction on the ground that by reason of the relations of the complainants to the General Electric Company and the Thomson-Houston company to the defendant said complainants are equitably estopped from seeking to enjoin the defendant from making incandescent lamps.

6. That the court did not refuse the said injunction on the ground that the General Electric Company is the successor of the complainants and the real party in interest in this suit.

7. That the court did not in view of the laches of the complainant and their predecessors in interest and the large investment which has been made by the large manufacturing companies associated in interest with it require as a condition of the granting of such injunction that the complainant should supply incandescent lamps to the defendant or the users of apparatus manufactured by it upon reasonable terms.

8. That the court did not stay the said injunction until the first day of January, 1893, in order to enable the defendant and its customers to secure a proper supply of incandescent lamps not infringing the patent in suit, which the Westinghouse company is making diligent preparations to furnish.

9. That the court did not except from the operation of the said injunction the stock of lamps defendant now has on hand.

10. That the court did not limit the injunction to the second claim of the said patent.

11. That the court did not refuse the said injunction as contrary to equity.

The following is a briet summary of the arguments for the Sawyer-Man Electric Company.

First Point.—Vested interests of great magnitude have grown up as the direct result of gross laches on the part of complainants and their predecessors in interest in not asserting their right under the patent in suit; the enforcement of the injunction would not only involve irreparable injury to such vested interests, but would cause great inconvenience to the public and throw a large number of workmen out of employment, and this, especially in view of complainant's laches, would be inequitable. Under this heading the following propositions are maintained:

a. Complainants were guilty of gross laches; first, in not commencing any suit on this patent until May, 1885; second, in not proceeding with such suit until January, 1889.

b. By reason of complainants' laches, and justifiably believing that a supply of incandescent lamps could be procured for general use, the Westinghouse company and others invested large sums of money in the creation of plants for the manufacture of such electrical apparatus, and the property so created would be practically lost if such lamps could not be procured for use in connection therewith.

c. For the same reasons the general public have invested enormous sums in the purchase and erection of such other electrical apparatus which is in actual use for electric lighting purposes, and which would be a total loss unless incandescent lamps can be procured for use therewith.

d. The court must consider that as this injunction stands no incandescent lamps can be procured for use in connection with the apparatus so held and used by the public or manufactured by the Westinghouse and other companies.

e. It results from the foregoing propositions that other manufacturers of electrical apparatus have been led by the complainants' laches into such a position that they would suffer irreparable loss if the injunction were to stand.

f. It also results that the public has been led into such a position that they would suffer great inconvenience and loss from the injunction.

g. According to the course and principles of courts of equity no injunction that could lead to the above described results ought to be granted.

I. The law whereby the courts possess the power of injunction in patent causes contemplates large discretion in the exercises of that power, and it follows that the court is not bound to grant an absolute injunction and that it may, in any case, withhold an injunction altogether when to grant it would not be in accordance with the course and principles of equity.

II. The courts in the exercises of their discretionary power do not hesitate to withhold an injunction in a patent cause even after final hearing.

III. A well recognized reason for withholding an injunction in patent suits, whether on preliminary motion or after final hearing, is laches on the part of complainant; and, in fact, the courts have gone so far as to defeat equity jurisdiction altogether on this ground.

IV. Another well recognized principle of courts of equity applicable to patent cases as well as to other classes of suits is to withhold the injunction when the benefit to accrue to the plaintiff from the granting of the injunction will be over-balanced by the inconvenience and injury resulting to the public.

V. This is a preliminary injunction, and, therefore, it is peculiarly within the discretion of the court to withhold it or to impose conditions upon granting it.

VI. It is no answer to the objection that the injunction will destroy vested interests and cause public inconvenience to say that the persons who will thus be injuriously affected are not parties to the record.

Second Point.—The injunction should have been refused because the General Electric Company, the real party in interest, intends to make an unconscionable and inequitable use of it.

The defendant's paper shows that the General Electric Company intends to make use of the monopoly of incandescent lamps to destroy the business of the Westinghouse company in the manufacture and use of dynamo machines and other apparatus besides incandescent lamps, and it proposes to accomplish this by refusing to supply any lamps for use with the Westinghouse generating apparatus. It also proposes to use the monopoly of incandescent lamps for the purpose of forcing all central station companies using Westinghouse dynamos to discard them and purchase machines made by the Thomson-Houston company or the Fort Wayne company, as is shown by its confidential circulars to its agents.

I. It is an established principle of courts of equity that the owner of a patent shall not be allowed to make an oppressive, unjust or unconscionable use of it, and the courts will lend their aid by withholding an injunction or issuing a mandamus, as the case may be, to prevent such abuse of the grant conferred by letters patent.

II. The facts of the present case bring it within the principle of the above authorities and forbid the granting of the preliminary injunction which the complainants are seeking to obtain.

Third Point.—No injunction ought to be granted in this case, because it is asked and would operate in aid of an inequitable and illegal combination in restraint of trade tending toward unlawful monopoly and contrary to public policy.

I. Of course a patent right is in its essence a monopoly and a lawful monopoly, but it is no more a monopoly than the ordinary rights of property.

II. The complainants in this suit are component parts of a combination between the several owners of different competing patents, under which a general competitive trade in apparatus for the manufacture of electric light and power has hitherto been carried on throughout the country.

III. The arrangement shown by the papers is not in its nature an acquisition of several competing properties by one person, and it is not necessary for the court to pass upon the question whether the laws against the creation of monopolies limit the right of acquiring property. This arrangement is in its nature simply a combination or pooling arrangement.

IV. That the object of this combination is to prevent competition and create monopoly in this branch of trade cannot be doubted.

V. The combination under consideration is against public policy and unlawful.

VI. The fact that the pooling of stocks of the combined companies was accomplished through the instrumentality of a corporation, so far from legalizing the transaction and putting it upon a better footing than ordinary trusts, adds another element of illegality to the transaction.

VII. The course so pursued by the applicants for the General Electric Company's charter shows clearly their apprehension that, if they disclosed their real purpose to the legislature, that body, instead of relying upon a prohibition in general terms, would specifically prohibit their contemplated action, or would refuse their charter altogether.

VIII. This injunction is sought in aid of the combination above described.

IX. It follows that the complainants do not come into court with clean hands. In respect to the very subject matter of contention they have been guilty of conduct in violation of the fundamental conception of equity jurisprudence, and they can obtain no relief from a court of equity.

Fourth Point.—The relations of the parties to the suit are such that the complainants are equitably estopped from seeking to enjoin defendant from making incandescent lamps of the character it is now making.

I. Equity will consider the real relations of the parties and disregard the form under which such relations are brought about.

II. The General Electric Company is in substance a copartnership between the complainants and the Thomson-Houston company with the active business management of the copartnership in the hands of the Thomson-Houston company.

Fifth Point.—The injunction should be refused because it is sought in aid of an attempt on the part of the General Electric Company, the real party in interest, to take an inequitable advantage of the contract relations established between one of its constituents, the Thomson-Houston company, and the defendant and its associates prior to the combination by which the said General Electric Company was formed.

I. The complainants are acting inequitably by entering into combination with the Thomson-Houston company so as to secure for themselves a share of the benefits accruing to that company from its agreement with the defendant and at the same time seeking to exclude the defendant and its associates from all benefit accruing to them under the said agreement.

II. Because of the inequitable conduct of the complainants in this regard the equitable relief now sought should be refused.

Sixth Point.—The injunction, if granted at all, should have been conditioned upon complainants agreeing to supply lamps to defendants or its customers on reasonable terms.

I. The court should not grant an unqualified injunction unless it is absolutely essential for securing for the plaintiff the direct and legitimate benefits of exclusive manufacture and sale of lamps.

II. An unqualified injunction is not necessary for securing to the complainants all legitimate advantages arising from a monopoly of the manufacture and sale of incandescent lamps under the patent in suit.

Seventh Point.—The injunction should have been stayed in any event until Jan. 1, 1893, in order to enable the defendant's associates and customers to procure lamps not covered by the patent.

Eighth Point.—The defendant should in any event have been permitted to dispose of the stock of lamps it has on hand under proper condition as to accounting and security.

Ninth Point.—The injunction as granted is too broad, and should in any event have been limited to the second claim of the patent.

The argument for the complainants—the Edison Electric Light Company and the Edison General Electric Company—was briefly as follows:

I. It is assumed that the title of the plaintiffs, the validity and scope of the patent and the fact of infringement by this defendant are not only clearly made out but are undisputed.

II. The privity of the defendant with the former litigants will not be seriously, if at all, disputed, but it may be useful, however, to point out that the proofs show not merely privity, as that term is understood in law, but that the United States Electric Lighting Company and the Sawyer-Man Electric Company are mere names under which the Westinghouse Electric Company has carried on and defended in the courts the lamp making infringements complained of in the present and former suits. The Westinghouse Electric Company, which controlled and managed the defense in the former suit, and which, doubtless, controls the present defense, has been, therefore, the actual infringer of the Edison patent rights, using the passive Sawyer-Man Company as a mere departmental agency in its business.

III. Assuming the above points to be determined favorably to the plaintiffs it is necessary to consider so much of the defendant's affidavits as allege, (1) the laches or acquiescence; (2) a disqualification of the plaintiffs to claim the protection by injunction of their rights secured by patent because of (a) the alleged illegal conduct of the General Electric Company, (b) an alleged estoppel binding the Thomson-Houston company; (3) a purpose on the part of the plaintiff to use its injunction oppressively and beyond its fair legal right; (4) that public convenience, comparative hardships to be suffered by the plaintiffs and defendants from the granting or refusal of an injunction, and other reasons, establish equities in the defendants so superior to the equities and legal right of the plaintiffs as to deprive the latter of the right to that protection in the exclusive enjoyment of the rights secured by its patent. In addition to these subjects the assignments of error present for consideration imputed errors in matters which do not so clearly appear there, if they appear at all.

IV. *As to laches, acquiescence.*—This court, in the closing words of the opinion in the case of the Edison company vs. The United States company, said, "nor do the facts make out such a case that *injunction should be refused* on any theory of laches or equitable estoppel by reason of undue delay in bringing suit or acquiescence in known infringement." Certainly no question arising upon these defenses would, without new facts, now be open for discussion by the United States company in this circuit, and probably not in any other circuit, or other place short of the Supreme Court of the United States. The present defendant does not set out in its affidavits any new facts tending to support these old defenses.

V. *As to the supposed effect upon the equities of these plaintiffs of (1) the alleged illegal conduct of the General Electric Company, and (2) of the alleged estoppel binding the Thomson-Houston company, and (3) of the alleged combination of the complainants and others, etc.*

The inventor's position before the law in respect to the process provided for his protection is peculiar. The proposition made to him by the general scheme of law is that if he will invent, and describe clearly his invention, and put it in such form that the public can readily avail of it after a certain time, he shall have during that time the exclusive right to use it, and jurisdiction is provided to protect him in that exclusive right by the process of injunction, which when he has clearly and beyond all reasonable right established his invention at law, ought to be rendered him by equity. This claim upon law was earned and enjoyed by Mr. Edison and by him assigned by mesne conveyance to the co-plaintiffs, but upon the theories of the defendants this has been lost, and the loss has happened without any adjudication, condemnation or resumption by the government or other judicial or ministerial proceeding or determination, and this has happened so effectually, it is claimed, that it is to be taken as conclusive and the process of the court, which clearly entitled any petitioner to its relief, is to be refused.

The charter of the General Electric Company provides "This act should not be construed as granting to the corporation hereby created the right to create or maintain any monopoly or unlawful combination in restraint of trade." This, together with the general provision of the stock corporation act of New York forms all the protective law of the case.

The suggestion that, as the court is on its equity side, being asked for something which is spoken of as a matter of discretion, it may refuse customary protection of its legal rights to a suitor because his associates are of doubtful character, leads far away from those ordinary and plain

ways in which courts of equity have heretofore administered justice.

As to the formalities and substance of the charges it will be noted that they do not include any direct and affirmative allegation that the "contracts," "combinations," "conspiracies" and "monopolies," complained of related to "trade and commerce, which is shown to be, among the States and with the foreign nations, etc." Specifications which would reduce these generalizations to something which could be taken hold of and the proofs which would sustain these specifications are to be looked for solely in the affidavit of George Westinghouse and its accompanying exhibits and in the charter of the General Electric Company, but scrutiny of these papers shows that not even the least evidence proving that anybody has done, or attempted to do anything forbidden by the act of Congress appears throughout the entire papers read in opposition.

From the sale of shares by stockholders who had *power to sell* and a purchase by a company which had *power to buy* this court is asked (1) to make the deduction that somebody (not named) had made a "contract" or "combination in the form of a trust or otherwise" or "a conspiracy in the restraint of trade," and after convicting these absent strangers without a hearing (2) to apply the punishment due to them to two corporations, which corporations could by no possibility have had in their corporate character any connection with the culpable acts, if there were such acts.

In respect to the charges of monopoly, if specifications were given, it would at once be necessary to open the inquiry whether the facts specified really constitute a monopoly at the common law, and that inquiry, this court sitting as a court of equity, could not effectively pursue—to any final judgment—and it is really the enforcement of a final judgment between the original parties which now demands its process. But no specific act of monopolizing has been pointed out.

VI. *As to the alleged estoppel binding the Thomson-Houston company*, it is to be an estoppel which, because one of two infringers sells out to the other, shall reach over to and paralyze the complainants acting in their independent corporate capacity on behalf of stockholders, some of whom are certainly not the General Electric Company. After an examination it is impossible to regard this claim of estoppel seriously.

As to the charge of inequitable conduct on the part of the General Electric Company.

In December, 1888, an agreement was made between the Thomson-Houston Electric company, the Consolidated Electric Light Company, the Westinghouse Electric Company and the Sawyer-Man company, by which it was provided that the Thomson-Houston company should have a license under the Sawyer & Man patents owned by the Consolidated company to manufacture incandescent lamps for use with generating apparatus of its own manufacture *only;* and binding the other parties not to supply any incandescent lamp for use with generating apparatus made by it. That agreement seems to be a natural and a fair one. It is claimed that the General Electric Company is taking advantage of the said agreement to exclude the defendant and the Consolidated company and the Westinghouse company from supplying any lamps for use with the Thomson-Houston generating apparatus. Just how this happens is not clear, for apparently it is their agreement which excludes them from supplying lamps for that use. As to the charge that the General Electric Company is seeking also to extend the application of said agreement by inducing owners of generating apparatus of other manufacture to discard it and purchase Thomson-Houston generating apparatus by intimidation and threats, it is without foundation, and, moreover, the General Electric Company has a perfect right to seek to extend its business.

The defendants have no ground whatever on which to base their inferences of an unlawful purpose to restrain trade, etc., except that union of interests which had been effected by the General Electric Company's purchase of most of the shares of the Thomson-Houston and Edison General Electric Company, a procedure which has not only no sign of restraint of trade in it nor any monopoly, but is expressly authorized by the laws of the State. Unlawful purposes must be proved or be necessarily inferred. Moreover there has not been even the slightest attempt at proof.

VII. *As to the allegation of an intention by the Edison interests to use the injunction inequitably and unconscionably.*

The idea of an arbitrary, unreasonable and uncompromising refusal to supply lamps expressed by the answer, turns into quite a different thing in the proofs, viz. (1), that the supply to former infringers may be accompanied by some *conditions* about the apparatus that they will use; (2), that the complainants will defend their contracts with their long suffering licensees, who, though they have bought and paid for an exclusive use in their territory of the Edison electric light, have not, down to the present time, had one hour of exclusive enjoyment.

This last ground introduces a very large and important class of persons whose rights are involved in the decision to be granted and whose claims more than balance the so called equities of those infringing users who took the chances and have thrived by disregarding their rights.

The affidavits of Mr. Westinghouse and others and the accompanying exhibits afford no real or substantial proof, and the pretence of a "policy" to refuse lamps is extravagant and unsupported by proofs.

That the inventor should be obliged to sell his lamps at a fixed price is manifestly unfair and the terms of the legal engagement to the inventor and the law are plain and simple and no such qualifying conditions are intimated. The defendant's proposition to continue infringing under an arrangement to be forced upon the complainants by the court is not only unjust but absurd.

VIII. *As to the alleged public inconvenience and undue hardship of the defendant.* As to both these considerations the complainants stand upon their legal right and ask for justice. The case is one in which all the moralities as well as all the legal considerations warrant and demand an unflinching application of the law. No one has to bear any hardship other than that which he voluntarily took the risk of. Furthermore, no general public is interested here, but only a sort of private public, that is, a few people who are interested in the lamp business. The alleged hardship of the defendant is a consequence which must have been foreseen, and which is not entitled to serious consideration.

IX. A balancing of equities shows a great preponderance in favor of the complainants. The patent in suit gave to the world a new art. While the lamp is but a small portion of the entire system it is the heart and soul of it, and it is that which makes a market for the other subsidiary inventions and devices. If legal rights had been respected the complainants would have sold most of the incandescent apparatus of every kind in this country, for they would have controlled its manufacture and sale through the sale of the lamp; this is a perfectly fair and incidental advantage like that which courts of equity often accord to mere diligence.

X. As to the remaining questions suggested by the assignment of error, it may be stated (1), it is clear that this court does not regard the complainants guilty of any laches; (2) that the complainants should supply incandescent lamps to the defendant on terms to be fixed by the court is inconsistent with the declarations everywhere set out by the court of the perfect right of the patentee to the *exclusive* use of his invention, (3) that the injunction should be stayed and infringement permitted until Jan. 1, and that the court should except from the operation of the injunction the stock of lamps which defendant now has on hand, both these seek their legal basis in the pretence of laches on the part of the complainants and of an innocent error on the part of the defendant. Neither of these conditions have ever had any existence.

XI. The discretionary power of the court ought not to be available to the defendant under these conditions. The court is asked to bear in mind that the decision in this motion will be a precedent in other circuits and in other cases. The position of complainant throughout the country may be exactly as if they had not won their suit if the court refuses an injunction.

The solicitors for the defendants were: Kerr & Curtiss: counsel, Edmund Whetmore, Elihu Root, Leonard E. Curtis. The respondents were represented by Dyer & Seely and Clarence A. Seward, Grosvenor P. Lowrey and Richard N. Dyer. The attorneys on both sides had been interested in the former suits and were peculiarly well fitted for the argument of such an important case.

Telegraphing Without Wires.

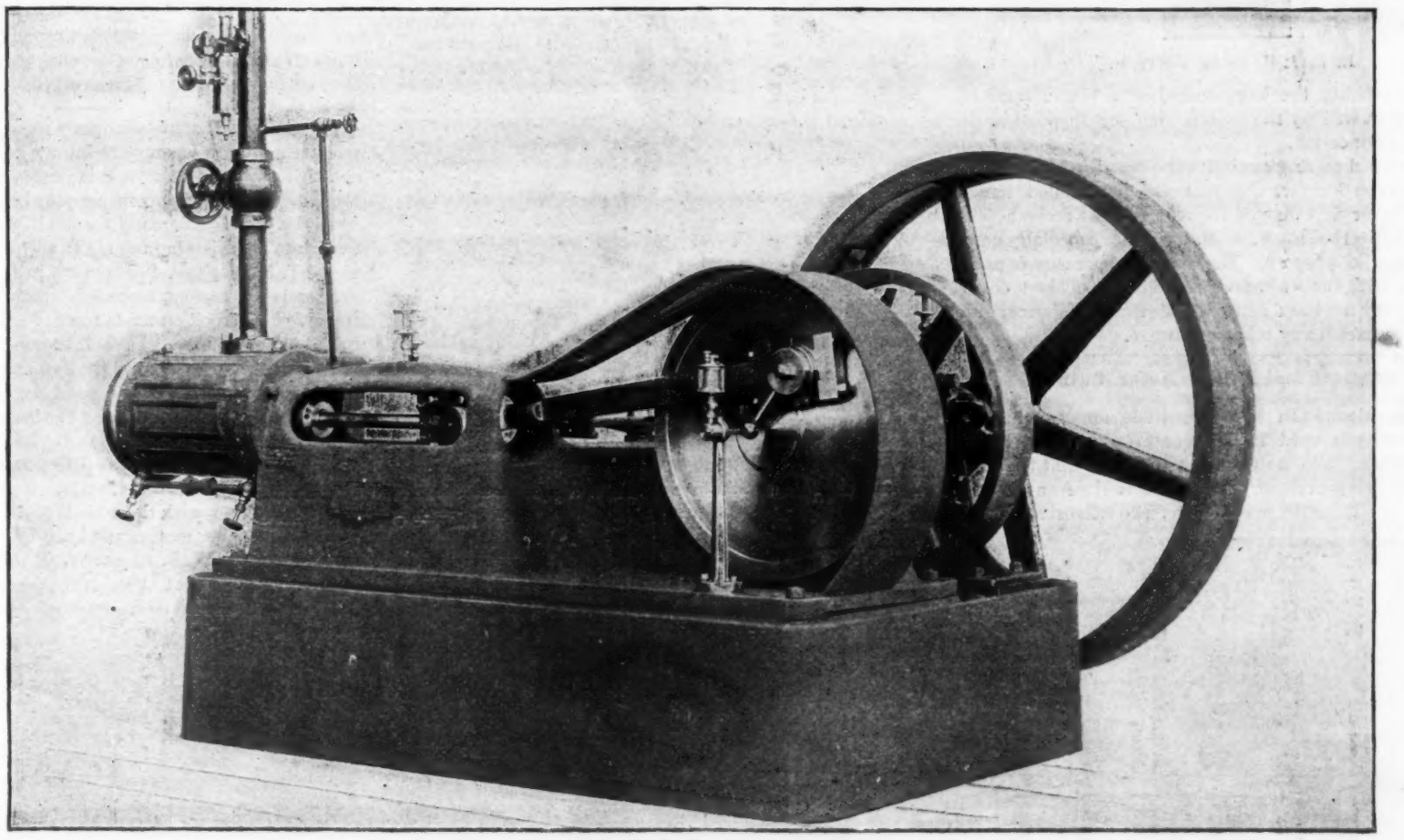
Since June last constant electric communication has been maintained between the Needles lighthouse, England, and the shore without any direct metallic connection. An ordinary submarine cable has been laid in Alum Bay to within sixty yards of the Needles Rock, where it terminates with its copper conductor attached to a small anchor. This anchor is in five and a half fathoms at dead low water. The shore end of the cable is attached to the signaling instrument, while to establish the circuit a simple earth plate is immersed in the water close to the shore on the lighthouse rock. Two strong bare wires dip into the sea about ten yards apart, which are in connection with the signaling instruments in the lighthouse. Thus through the intervening space of sixty yards the men on the rock can call the attention of those on shore or vice versa by means of an electric bell, and communication can be established by means of a single Leclanché battery cell.

Electric Light Engines for Steamboats.

When contracting for electric light plants for the fine new steamers of the Menominee Transit Company, Cleveland, Chief Engineer Calder required, as a preliminary condition, that special engine designs be submitted. It is frequently necessary, in marine work, to provide the engine with an iron sub-base of strength and weight—one that will make the engine absolutely self-contained. Moreover, the governor must be especially easy of access, both for taking up and for lubrication, and be of such design and construction as to regulate within the least possible percentage while remaining insensible to the motion of the boat.

To meet these conditions the John T. Noye Manfacturing Company, of Buffalo, N. Y., designed the engine which we illustrate herewith. The six engines furnished have needed no repairs or extra attention during the season, and are now, at its close, in perfect condition, although much of the time they have run with a steam pressure of 150 pounds instead of the 100 allowed for by the builders.

These engines are of 6-inch bore, 10-inch stroke, and run at 300 revolutions. The top of the fly-wheel turns toward the cylinder, but can be made to run the other way if desired. The governor is an adaptation of that used on the Noye heavy duty engine, and insures perfect regulation.



THE JOHN T. NOYE ELECTRIC LIGHT ENGINE.

The Society of Naval Architects and Marine Engineers.

An important professional society, modeled after the celebrated English Institute of Naval Architects, has been recently provisionally organized under the title of the Society of Naval Architects and Marine Engineers, and a permanent organization will be effected at the first meeting of the Council in January.

The object of the society is the promotion of ship-building, commercial and naval, and to further this object annual meetings will be held for the reading and discussion of appropriate papers and interchange of professional ideas, thus making it possible to combine the results of experience and research on the part of ship-builders, marine engineers, naval officers, yachtsmen, and those skilled in producing the material from which ships are built and equipped.

This promises to be one of the most important and exclusive of the professional societies, and as electrical engineers connected with marine work are eligible for associate members we hope that many of those qualified will take advantage of the opportunity to join and thus be in a position to advance notably the interests of an important branch of the electrical profession.

The provisional officers are as follows: President, C. A. Griscom, of the International Navigation Company (which includes the Inman line); vice-presidents, Chief Constructor T. D. Wilson and Engineer-in-Chief G. W. Melville, United States Navy; C. H. Cramp, G. W. Quintard and I. M. Scott, the heads of the three great ship-building yards of the United States; General F. A. Walker, of the Massachusetts Institute of Technology, and W. H. Webb, the celebrated designer of clipper ships.

Inquiries for information and applications for membership should be addressed to the secretary, W. L. Capps, 1710 F street, N. W., Washington, D. C.

E. E. & S. Snap Switch.

The accompanying cut illustrates a snap switch for incandescent circuits. It is neatly encased in an iron receptacle, and is made by the Electric Engineering and Supply Company, of Syracuse, N. Y. It is especially designed for the conduit system of wiring. The receptacle will admit a 5 and 10 ampère switch, either single or double pole, and is made in a variety of styles, so they can be located almost anywhere in the line, and with openings to accommodate any sized tube, single or duplex.

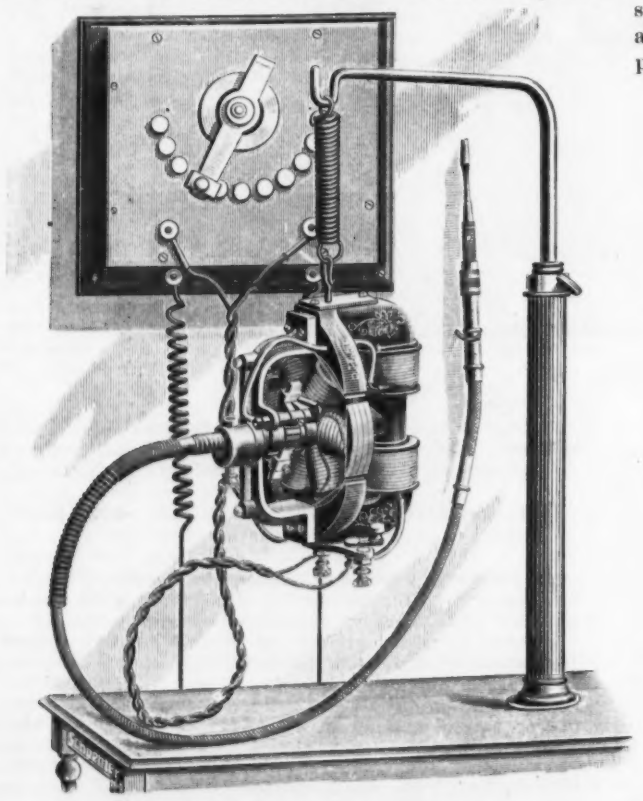
The receptacle can be inserted into the walls when the building is in course of erection, and the switch put in and connection made at any time thereafter to suit the convenience of the builder. The covers are made concave, forming a deep recess, by means of which the key or thumb piece is set into the receptacle. This cover is easily removed by detaching the key, and then a slight turn in either direction will lay the switch open for inspection or for making connection.

E. E. & S. Snap Switch.

A highly polished ring encircles the opening of the box and protects the decoration or frescoing from soiled hands when the cover is removed for repair. The receptacle is furnished with the E. E. & S. switches especially constructed for the purpose. The entire apparatus is practically flush with the wall, and the highly polished cover makes it a very neat and attractive device. The cover can be finished to match any other hardware.

A Surgical and Dental Motor Outfit.

The average electrician has very little idea to what an extent electricity is used in the treatment of diseases and in surgical work. We notice, with interest, that the Edison Manufacturing Company has come to the front in this class of work. Its cells, we believe, are extensively used for both galvanic and cautery work, and the company is continually adding novelties to its appliances. One of the most interesting appliances is the new motor equipment for surgical and dental work. Although motors have been used for some years by both the dentist and the surgeon, the Edison Manufacturing Company has spared no expense in placing on the market an outfit which in efficiency, it is claimed, cannot be equalled.



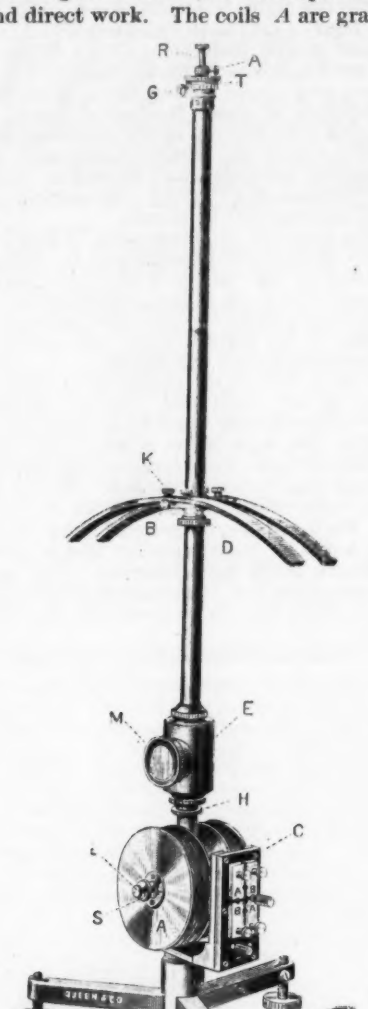
A NEW DENTAL AND SURGICAL OUTFIT.

The motor, equipped with a flexible shaft hand piece and sheath, is suspended from an adjustable standard. The power is derived from six Edison-Lalande cells, type P which will give 200 hours' work, either continuous or intermittent. The speed of the motor is regulated by a rheostat, and the motor itself, which is of a slow speed variety, has self-oiling bearings.

The accompanying illustration gives a fair idea of the general appearance of the outfit. They can be seen, however, in actual operation at the company's offices, No. 110 East Twenty-third street, New York City.

Queen's Dead-Beat Reflecting Galvanometer.

The instrument illustrated herewith is a modification of the Weidemann galvanometer, and is adapted for both differential and direct work. The coils *A* are graded, having five changes of wire, and slip upon copper rods forming part of the damper. Automatic connections are made with the binding posts on the switchboard *C* by means of small spring contacts upon the back of the board which press against platinized studs attached to the coils. By shifting plugs on the switchboard the coils may be quickly connected in series, multiple, or differentially. To obtain perfect differential adjustment a horizontal movement of the coils is secured by turning the micrometer screw *S*.



Queen's Dead-Beat Reflecting Galvanometer.

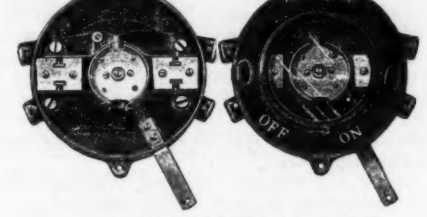
The vertical tube is 24 inches long. The suspension being quartz fibre instead of cocoon silk, torsion is practically eliminated while great tensile strength is secured. An essential feature of the apparatus is the arrangement of control magnet employed. In place of the usual single piece with the suspension tube passing through it, the magnet is divided into two parts, each of half the usual cross-section, as illustrated.

The advantage claimed for this construction is that should it be necessary to make very delicate observations in the vicinity of the instrument, the magnets may be temporarily removed without disturbing any adjustments, and then replaced in exactly the same position. Owing to the mass of copper in which the magnetic system moves, the galvanometer, it is said, is almost absolutely dead beat, and observations may be taken in rapid succession.

This apparatus is of recent design and placed on the market by Queen & Co., Philadelphia.

Powers' Arc Light Cut-Out.

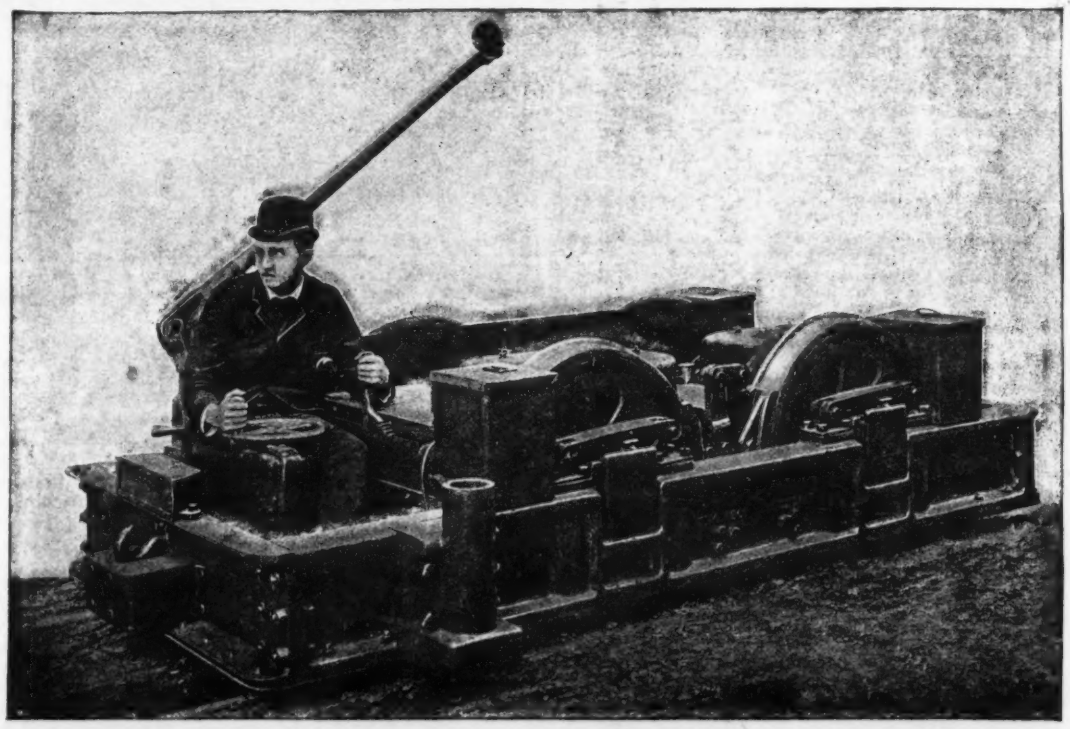
We illustrate a well known arc light cut-out that has recently been much improved. As now manufactured by the E. G. Bernard Company, Troy, N. Y., all the insulating parts are of porcelain, including bushings where the leads enter the case, and the number of parts has been reduced to a minimum. The case is absolutely weather-proof and the cut-out can be used outdoors in the most exposed position with perfect success. By reference to the cut it will be seen that the construction is very simple; the snap locking action is secured by a spring of peculiar shape that has been found to prove very efficient in its action. The cases are made with either metal or glass faces. In its improved form this cut-out is likely to become even more widely used than at present and is an example that cheapness and relia bility are not always opposed to each other.



Powers' Arc Light Cut-Out.

The General Electric Company's T. M. M. Mining Locomotive.

The General Electric Company recently placed upon the market a mining locomotive known as the T. M. M. type, and this company is now bringing out a new mining locomotive, shown in the accompanying illustration, designed to meet the growing demand for small, substantial, low-priced machines of this character. It will be known to the trade as the T. M. M. type, and consists principally of two standard railway motors, mounted upon a heavy iron truck frame. The truck frame is built of cast iron side frames, bolted to heavy steel channel beams, which are securely fatened together by a wrought iron angle plate. The axle bearing boxes are small and solid in construction, easy of access for oiling and replacing the brass linings. The frame of the locomotive is hung from the axle boxes by means of steel springs, so that there is little pounding upon the track. By this method of construction it is possible to take the motors, together with the wheels and axles, entirely out of the frame. The motors used are of the standard railway type, either the W. P. 30 or W. P. 50, as required. For gauges narrower than three feet special four pole motors have been designed, which will run on gauges as narrow as 18 inches.



THE GENERAL ELECTRIC COMPANY'S T. M. M. MINING LOCOMOTIVE.

The controlling mechanism used is the standard series parallel controller. The brake is a powerful form of steel screw and lever. No adjustment is necessary for the wear of the brakes used, as the steel screw takes up the lost motion until the shoes are worn out. The trolley is of the single arm insulated type, and may be moved from one side to the other of the machine, as occasion may require. As the motors are self-protected, no cover for the locomotive is considered necessary, but one can easily be supplied. The cover increases the total height of the machine four inches. Sand boxes are provided for both front and rear wheels. All of the controlling levers are placed on the platform of the machine, within easy reach of the operator.

Electrical Measurements in the Ewing Test of the Parsons Steam Turbine.

In our last issue we published an abstract of Prof. Ewing's report on the improved Parsons steam turbine. Of the three tests he speaks of, two were made with continuous current dynamos and one with an alternating current dynamo, and as the results agree within less than one per cent. it may be of interest to those engaged in such testing to know what methods and instruments were used. We therefore give here the whole of that part of the report which refers to these electrical tests. The tests referred to are those the results of which are indicated by small circles on the curves of Figs. 7 and 8, page 376, in our issue of last week.

In the first set of trials a continuous current armature was used, measurements being made for six different grades of output from no electric load up to a load in which the output was at the uniform rate of 102 Board of Trade electrical units per hour, the current being spent on a bank of coils. The results of these tests are shown by the curves *c c c* in the figures referred to above. The output given is that in the external circuit only, and therefore does not include that of the exciter.

The volts were measured by three Cardew voltmeters, which were tested against each other, and one of them against a Thomson balance. The ampères were measured in the following way: A low resistance frame consisting of many bare thick wires of platinoid, grouped in parallel, was arranged as a shunt to a mirror galvanometer, which was provided with a strong controlling magnet, so that the whole current of about 400 ampères could pass without causing an inconveniently great deflection, and without heating the wires of the shunt materially. In series with this was placed (1) an Evershed ampèremeter which had been carefully calibrated by reference to a Thomson balance, and (2) two Siemens electro-dynamometers, one of which could take the strongest current, while the other was suitable for comparatively weak currents only. The constant of the shunted mirror galvanometer was determined in the low power trials by comparing its deflection with the readings of the Evershed and of the more sensitive of the two Siemens instruments. These were then cut out to allow stronger currents to pass, and in the trials under heavy load a further check on the constant of the mirror galvanometer was furnished by the readings of the larger electro-dynamometer. The mirror galvanometer, the constant of which remained unaltered throughout, served to connect the readings of all the currents, from the lightest to the heaviest loads. The agreement between the various measurements was perfectly satisfactory.

The second set of trials was also made with continuous currents, the results of the three measurements being shown by the curve *C C C* in the figures referred to above.

In the third set of trials the alternate current armature was used, giving 2,000 volts at a speed of 4,800 revolutions per minute, which made the frequency of 80 periods per second. Here the current was directly measured by the Evershed and Siemens instruments, and the volts were determined by (1) a Cardew voltmeter furnished with a resistance specially wound to enable it to read 2,000 volts, and independently (2) by another Cardew voltmeter with a step-down transformer having a ratio of one to twenty. The output was taken to be the product of the effective volts and the effective ampères. In these alternate current trials the electrical energy was absorbed by a water resistance formed by sticking two rods, to serve as terminals, some 10 yards apart in a pond, the amount of resistance between them being adjusted by pulling the rods out or in to expose more or less of their surface to contact with the water. The close agreement of them with the corresponding continuous current trials conducted in this manner shows that the effects of lag in the external circuit are immaterial; in other words, that the electrical work is properly measured by multiplying the effective volts by the effective ampères. The difference between the alternating and continuous current measurements is less than one per cent. of the output at full load.

Obituary: George H. Meeker.

The death of George H. Meeker occurred in Chicago last week. His death is universally and sincerely deplored by a very large circle of friends, including both social and business acquaintances. Mr. Meeker has been for about two years the Western Manager the of New York Insulated Wire Company. Having started life with the Fairfield Rubber Company, of Fairfield, Conn., at the very bottom of the ladder, he rapidly rose in favor with that company and was made manager of the New York department. He left this work to engage with the Insulated Wire Company as traveling salesman and it was only after one year's service with that company that he was appointed to a position in Chicago, which he held at the time of his death. He was a man of strong character and most genial disposition. Mr. Meeker always took a most active interest in the Chicago Electric Club, and in him that organization loses one of its strongest members, as was testified by the resolutions of regret which were passed at a special meeting held on Wednesday noon. Mr. Meeker's death resulted indirectly from a severe cold contracted at the funeral of his grandfather, which took place at Astoria, N. Y., two weeks ago.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Dec. 10, 1892.

New York Electrical Stock Market.—This class of securities experienced considerable activity, and if all signs are not at fault will rise into prominence ere long. Western Union, whose advance has set the financial world to talking, is fully treated elsewhere. A number of other stocks are receiving a general inquiry which is believed to be partially sympathetic. As the close of the year draws near, and business inventories are being completed, the finances of the country's industries are shown to be in better condition than was anticipated. This has given rise not only to a feeling of confidence, but a desire on the part of capital to seek investment. The electrical stocks will participate in these benefits. We note an inquiry for a number of the high priced telegraph stocks, viz., Central & South American Cable, Mexican Telegraph and Northwestern Telegraph. Not one of these securities has been bid or offered in weeks, neither has a transaction been recorded. The feeling is that they may be brought into some degree of activity.

General Electric.—Last week when the stock was selling around 111 we predicted that it would follow the general market. This has been verified by an advance this week as the annexed table will show. The support came from investment buying. The volume of transactions was small and indicated an almost neglect by the room traders. The highest point reached was 114. Its course next week, if let alone by speculators, will follow that of the general market. The bonds were active, $74,000 selling at 99¾ to 100½. This is to be compared with 105 before the $6,000,000 increase was made and owners feel that they can afford to hold them, and do not look upon the decline with any great degree of appehension. The transfer office of the company has been moved to the eighth floor of 44 Broad street. The semi-annual dividend of 3½ per cent. on the preferred stock has been declared. Books close Dec. 17 and reopen Jan. 3.

Westinghouse.—Nothing of interest in this stock developed during the week beyond the renewed efforts of the company to vacate the temporary injunction restraining it from using the Edison lamp. The matter was taken to the United States Court of Appeals, where it was fought upon the lines already laid down. An abstract of the argument in the case is given elsewhere. Decision was reserved. But one sale of the stock was recorded, it being a small lot of first preferred 7 per cent. cumulative at 98¼. The company will shortly establish a transfer agency with the New England Trust Company, Boston. The Boston Safe Deposit Company will act as registrar of the stock.

North American.—This stock dropped below 12 on Friday, which is the lowest point reached for some time. A well posted broker informs us that the decline was due to selling orders of parties who got in when the stock was selling around 14, and having become tired of holding on in expectation of a movement, let go. The entire transactions of the week would not equal one day's business in times of activity.

American District Telegraph.—The deline in this stock has not been satisfactorily explained. It amounted to about 2 points. The closing was weak. We hear rumors of an opposition concern to take the place of the Mutual District service recently absorbed, but do not credit them.

American Telegraph and Cable sold in an indifferent way around 84½ to 85. The advance in Western Union ought to be a good thing for the stock, and it is not all unlikely that it will at least recover lost ground during the ensuing week.

Edison Electric Illuminating.—There was manifest more or less of a disposition to buy this stock. As usual it fluctuated over quite a wide range, touching 107¾ and closing at 109½. It is a poor stock for speculators to buy, as a forced sale, owing to a lack of an active market, is always attended by a loss of ground. As an investment we can but repeat our former statements—"it is excellent."

Western Union.—The opening was 88½, the closing 96½, highest point reached 97. The course of this stock staggered all prophets and set the Street to guessing. Moreover, the guessing is still going on. In the half day of Saturday the advance was 4 points, which is equivalent to $4,000,000. The day before it was 3¼ points, and since Mr. Gould's death it has been about 12 points, or $12,000,000. This immense appreciation must have a clearly defined cause. Street theorists are busy manufacturing hypotheses, some of which are doubtless very near the truth. It is certain that some interests have been buying the stock on a large scale since Mr Gould's death. The Gould estate holds about one-fifth of the 1,000,000 shares, and these cannot come upon the market until the youngest child is of age, consequently the bulls no longer fear a deluge of stock in check of any upward movement. Moreover, one-fifth does not represent a control. Other large interests who have always had great faith in the property doubtless now see an opportunity to obtain control, and the buying may be with this in view. There are half a dozen other conditions which doubtless contributed to the advance, viz., the rumor that the property is to be listed on the London exchange; that the Gould estate is investing its spare cash in the stock; that the Vanderbilts are seeking control; that the company is soon to pay 7 per cent.; that Drexel, Morgan & Co. are to assume a prominent part in the management. These and others of a like nature and the attendant movement inspired room traders with the belief that their chance had come, and the advance in a measure was augmented by their operations. Before Mr. Gould's death, and since the increase in capital, we maintained that the stock was intrinsically worth about 80, and we cannot see how the various conditions which have since arisen can give it a par value. We will grant that in time they may do so, and that for a period sentiment may keep it above the 90 mark. It is common talk that the stock may cross par. There is nothing improbable in it. However, we maintain that the advance is largely speculative; it looks like the work of the old bull pool taking advantage of a very considerable short interest in the stock and of the restoration of confidence in the management to mark up the price and make a market for the new shares it received as the scrip dividend on its holdings.

Commercial Cable.—This stock was bid 178½ this week, and held at 180. A sale was made at 178. It continues to be firmly held, not so much because of its dividend paying policy, which is but 7 per cent., but because of its possibilities and the faith of the public in its management. A quarterly dividend of 1¾ per cent. has been declared, payable Jan. 2. The announcement is also made that $600,000 of outstanding debenture bonds will be redeemed, commencing Jan. 15. Transfer books will close Dec. 21 and re-open on Jan. 3.

Copper Market.—The demoralization which has ruled for a number of months among the copper wire men is in a fair way to be checked. Discounts have reached a point that bring the actual selling price of wire to about 13 or 13¼ cents. We understand that an effort likely to prove successful is being made to rehabilitate the wire pool. This will have a beneficial effect upon the copper market if successful. The asking price of the companies for lake copper is 12¼ cents, and it is doubtful if any large quantity can be obtained for less. There is talk of a probable attempt to put the price to 13 cents before spring. Consumers' stocks are only normal, and they are expected to buy quite generally after the yearly inventories are finished.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Dec. 10, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	56	56½	56	59
American Tel. & Cable..	100	14,000,000	84½	85½	84	86
Central & So. Am. Tel....	100	6,000,000	....	....	105	115
Commercial Cables.....	100	7,716,000	....	....	176	180
Gold Stock & Tel.....	100	5,000,000	....	....	100	103
Bonds.....	500	500,000	....	....	100	....
Mexican Telegraph.....	....	.....	....	....	175	190
Northwestern Telegraph.	....	.....	....	....	102	....
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	96,199,852	88½	97	95½	95⅝
Real estate bonds.....	1,000	1,219,000	....	....	....	
Debenture bonds.....	1,000	4,920,000	113½	113½	....	..
Collateral Trust 5's....	1,000	8,181,000	104¾	105½	....	
North American.....	100	39,767,200	11¼	12¾	12	12¼
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.....	100	6,500,000	107¾	109½	109	109½
" " Ists.....	...	.....	109	109	...	
" " Deb's...	....	.....	....	....	....	....
Edison El. Il. of Brooklyn.	100	750,000	....	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....	1,000	2,000,000	....	....	2	6
" Bonds.....	...	30,000	....	....	65	80
Edison Ore Milling Co....	...	2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....		65
General Electric	1,000	50,000,000	112¾	114	113¼	113½
Debenture 5's	....	10,000,000	99¾	100½	....	....
Automatic Exhibition Co.	...	2,500,000	....	....	3	5
Mt. Morris Electric.....	...	500,000	....	....	....	15
N. E. Phonograph.....	..	2,000,000	....	....	2	4
N. Y. Phonograph	...	2,000,000	....	....	2	3
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E. & M. Co. 1st p. 7 per cent., Cum.	50	3,717,253	98¼	98¼	....	....
E. & M. Co. Assg.....	50	5,038,116	...	....	....	....

BOSTON, Mass., Dec. 10, 1892.

The General Market.—The feeling in the market was so hopeful at the close of last week, immediately following the death of Gould, that it was thought to be a turning point after the depression that had for so long been forcing prices down lower and lower each day. The Monday market opened strong and active, reflecting a good condition, and with good prospects, but upon the reassembling of Congress a new discussion of the silver question commenced, and, whether or not it is a sufficient reason, it is no doubt a sufficient cause for the irregular and unsettled conditions that have continued all the week. A large amount of liquidation is the result, and prices are lower than they were last month. What little confidence the public may have in the market seems to have been lost, and the course of prices for the coming week is as uncertain as ever it was. The week closes with much of the late losses regained, and though the slight advance promises nothing definite for the future condition of the market, still it offers some contrast to a steady fall. Money is higher than since early in the summer, many loans being 7 per cent. From 6 to 7 is the prevailing price, and there is no doubt but that the top has been reached. The silver agitation and the refusal to use silver notes at the clearing house are what make available loaning funds so scarce.

General Electric and Westinghouse are the only electrics that attract any attention on the market, and these have had a quiet week, though the former has some days been quite active, though without any fluctuation. Considering the weakness of the general market this stock is certainly very firm. Some think it is too high, rather beyond a reasonable price considering what other 8 per cent. industrials sell for. The new bonds did not take well, and the query is, therefore, put, why should the common stock sell so high if the bonds have not a good market? When the issue was announced the preferred stock dropped two points, but the common remained practically unchanged. The actual market price is a safer criterion to go by than the collateral reasons for its rise or fall, and its strength is the best possible reason for the stock remaining at present prices. The same reasoning holds on Westinghouse. There is nothing in the affairs of the company to influence the price one way or the other, and it continues strong.

West End Railway stock closes at a little less than the dividend, as it is selling now ex-dividend, but its strength is very marked on this dull and unsteady market.

Telephone stocks are strong, perhaps because let alone, and have not materially felt the fluctuation of the rest of the list. Bell closes one point off at 207. New England at 48 bid.

Copper stocks are strong and nearly as high as the high figures of last week. The feeling is without exception very bullish on these, and they are very attractive just now.

Electric Bonds.—The most recent offering is the issue of the New Haven & West Haven Horse Railroad Company and Winchester Avenue Railroad Company, of New Haven, Conn. There are $500,000 first mortgage gold bonds. The company has a fully paid in capital of $140,000. The cash value of the property is placed at $1,000,000, on which are issued $500,000 bonds. In 1891 the gross earnings, operating entirely by horse power, were $110,389; net, $16,232. During nine months of 1892, with partial equipment of electric power during the last six months, the gross earnings were $112,862; net $49,000. The net earnings for the year are conservatively set at $30,000. Total fixed charges of 5 per cent. on $500,000 bonds, $25,000. left surplus earnings in 1891 applicable to dividends $21,000, or 15 per cent. Surplus earnings in 1892 applicable to dividends $35,000, or 25 per cent. The net earnings for 1893 under complete electrical equipment will approximate $100,000. There are about 30 miles of track operated, serving 100,000 people. The following ars the officers of the company: President, A. C. Pond, Boston; general manager, J. A. Kelsey; treasurer, S. A. Stevens; superintendent, A. E. Pond, all of New Haven. Directors: A. C. Pond, J. A. Kelsey, S. A. Stevens, S. H. Wagner, A. F. Mason. James Graham, E. P. Shaw. The bonds are offered by Spitzen & Co., of Boston, at 101⅛ and interest.

The Commercial Cable Company will pay a regular quarterly dividend of 1¾ per cent. Jan. 2, 1893. It has also been decided to redeem $600,000 of the outstanding debentures of the company on Jan. 15.

Other electric dividends are: Thomson-Houston Series "D" pays $1 50 per share Dec. 20 to stockholders of record Dec. 15. Northwest General Electric Company pays regular quarterly dividend of 2 per cent. on the preferred stock Dec. 15.

The Gloucester, Manchester & Beverly Street Railway Company, of Massachusetts, has filed a petition for incorporation. The road will be operated by electricity and run between

Beverly and Gloucester as terminal points, covering also Manchester, Essex, Wenham and Beverly Farms, the most attractive summer resorts on the North Shore, and will open up a very large amount of land suitable for residences not previously within easy access. The incorporators are W. H. Jordan, W. Frank Parsons and David S. Preston, of Gloucester; Henry W. Peabody, of Salem, and Lamont G. Burnham, of Boston.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series Co	sh	40,000	....	....	8	9
Thomson-Houston Elec.—Series D	sh	120,000	8	7⅞	7¾	8
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	....	....	7½	10
Westinghouse Elec.—New Com	..	6,000,000	36	34⅝	34½	35
Westinghouse Elec.—Pfd.	..	4,000,000	50	48¾	48¾	50½
General Electric	..	30,067,200	114	112	113	113½
" " Pfd	...	4,136,300	118	116	116½	117
Fort Wayne Elec	25	4,000,000	13	12¾	12¾	13
Fort Wayne Elec.—Ser. A.	sh	80,000	7⅞	7¾	7⅞	8
Detroit Elec	20	750,000	4½	....	4½	5
West End St. Ry. Co.—Com	50	7,150,000	*73¼	70¼	70	70¾
West End St. Ry. Co.—Pfd	50	6,400,000	*87	86½	84¾	85
American Bell Tel	100	15,000,000	208	206½	206½	207
Erie Tel. & Tel. Co	..	4,800,000	50	48	48	....
Mexican Tel. Co	10	1,280,000	90c.	....	90c.	1.00
New Eng. Tel. & Tel. Co.	..	10,304,600	59	58	....	59
Tropical Tel. Co	10	400,000	....	....	....	....

*Ex. dividend.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stocks furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago (ex sights)	200	215	Chicago Arc Light & Power Co	103¾	105
Central Union	56	58	Chicago Edison Co	170	....

NEW INCORPORATIONS.

The Northwestern Electric Company, Superior, Wis., capital stock $10,000, has been incorporated to manufacture and sell electrical goods. H. A. Burgess, W. W. Tuttle and J. P. Evans are the promoters.

The Brazil Electric Street Railway Company, Brazil, Ind., capital stock $50,000, has been formed to construct an electric railway in Brazil. The organizers are R. J. Smith, D. H. Smith and R. D. Fennant.

The Everett Light, Heat and Power Company, Everett Pa., capital stock $15,000, has been formed to supply light, heat and power at that town. H. Howard Hill, James C. Barndollar and John K. White are the organizers.

The Grand Rapids Electric Company, Grand Rapids, Mich., capital stock $25,000, has been formed to manufacture electric machinery. D. D. Cody, Daniel McCoy, and C. M. Ayer all of Grand Rapids, are the promoters.

The Campbell-Yates Company, Chicago, Ill., capital stock $25,000, has been started to supply electricity for power, heat and illumination, etc. Bayard S. Dimond, H. S. Campbell, E. G. Gigrand and Albert E. Yates are the organizers.

The Sterling and Rock Falls Interurban Railway Company, Sterling, Ill., capital stock $100,000, has been formed to build an electric street railway. E. W. Jackson, Sheridan Black and Robert N. Newton are the promoters.

The Columbia Electric Light Company, Philadelphia, Pa., capital stock $100,000, has been formed to supply light, heat and power by means of electricity. The incorporators are D. W Chandler, J. H. Jenkins and Edward J. Moore.

The Schuylkill Valley Electric Street Railway Company, Pottsville, Pa., capital stock $50,000, has been formed to construct and operate a street railway. Chas. H. Davis, Edwin Chamberlain and A. C. Milliken are the promoters.

The Bristol & Newtown Street Railway Company Bristol, Pa., capital stock $100,000, has been formed to construct and operate an electric railway in Bucks County, Pa. A. C. Milliken Edwin Chamberlain and Chas. H. Davis are the promoters.

The Caldwell Water Works, Electric Light and Ice Company, Caldwell, Tex., capital stock $50,000, has been started to furnish the public with light, water and ice. M. P. Kelly, B. R. Copeland, A. T. Bradshaw and A. J. Rosenthal, are the promoters.

The Newton Light, Heat and Power Company, Newton, Ia., capital stock $50,000, has been formed to operate a plant for furnishing electric light, power and heat. Jas. S. Cummins, H. S. Manning, O. H. Olsen, H. M. Vaughn and B. J. Arnold are the promoters.

The Dravosburgh Electric Railway Company, Dravosburgh, Pa., capital stock $15,000, has been formed to construct and operate an electric railway from Reynoldton to Dravosburgh, Pa. John M. Risher, Stephen S. Crump and Wm. H. Crump are the promoters.

The Greenfield Electric Light and Power Company, Greenfield, Ind., capital stock $30,000, has been formed to manufacture, generate and deal in electricity for light, heat and power, etc., and to erect plants, etc. Chas. G. Offutt, Orfile C. Irwin, and Robt. S. Thomson are the promoters.

The Metropolitan Railway Company, Tacoma, Wash. capital stock $700,000, has been formed to operate a general system of street and other railways, electric light plants, etc. Frank Allyn, W. R. Rust, H. C. Clement, S. C. Slaughter, F. L. Mead, and Grattan H. Wheeler, all of Tacoma, are the incorporators.

The General Electric Company, New York, N. Y., and Denver, Colo., capital stock $50,000,000, has been incorporated to manufacture everything connected with electricity, and the buying of plants in the United States, etc. J. P. Ord, S. Endicott Peabody, Frank S. Hastings, Jas. Jackson, S. Dana Greene and Eugene Griffin, are the organizers.

The National Automatic Fire Alarm Company of Lousiana, of New Orleans, La., capital stock $30,000, has been formed to sell electrical apparatus and appliances of all kinds for the communication of intelligence concerning fires by the use of automatic fire alarms. C. Edmund Kells, Jos. H. DeGrange, J. C Moris and L. M. Finley are the organizers.

The Mount Vernon, Bay View & Northern Railway Company, Mount Vernon, Wash., $150,000, has been formed to construct, operate and maintain street and other railroads, electric light plants and telegraph and telephone lines. The organizers are H. P. Downs, H. Clothier, G. E. Brand, J. B. Moody, G. E. Hartson, N. J. McKenne, J. F. St. John, Otto Klement and Fred E. Pape, all of Mt. Vernon.

The Jersey City, Hoboken & Rutherford Electric Railway Company, Jersey City, N. J., capital stock $300,000 has been formed to construct, maintain and operate a street railway. H. B. Hyde, L. Fitzgerald, T. T. Jordan, New York; C. H. Russell, C. Curie, C. A. Johnson, Brooklyn, N. Y.; J. A. Morisse, Paterson, N. J.; W. N. Ince, R. S Jordan, F. Irwing, J. S. Strang and O. H. Lohsen, Jersey City, N. J., are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Dec. 12, 1892.

Mr. Charles F. Beach, Jr., 35 Wall street, New York City, is giving special attention to the organization, consolidation and reorganization of street railway companies and to the negotiation and sale of street railway bonds. Mr. Beach is general counsel of the Missouri, Kansas & Texas Railway and also counsel for the Reading Railway Investigating Committee. Mr. Beach is the author of a two volume work on the modern law of railways.

Quick Transatlantic Cabling.—The United Press made a good record last week in transatlantic cabling. Having occasion to send to the Central News, London, an inquiry relating to a certain business matter, a dispatch was filed at the office of the Direct Cable Company, in this city, and in exactly 10¼ minutes a reply was laid on the desk of the general manager. This time has, of course, been beaten by this and other cable companies, but a better record has seldom been made without making some extraordinary effort to do so.

Wires Must Come Down.—On Wednesday of this week the Board of Electrical Control sent to the Mayor a long list of owners of overhead wires strung in streets where there are subways, and in violation of the regulations. The list included the principal electric light, telephone and telegraph companies and a large number of private wires. On the following day the Mayor sent the list to Commissioner Gilroy, with instructions to take down the wires, and at the same time an admonition to the police department to prevent further stringing of wires. Commissioner Gilroy on Friday directed Supt. Cummings, of the Bureau of Incumbrances, to remove the wires, and notices were sent to the offenders. On the next day three detachments of men, each in command of an inspector who acted under written instructions specifying the wires to be taken down, began the work. The wires were removed first in Reade street, College Place and Chambers street, and the companies affected were the Mt. Morris, Thomson-Houston, Brush and United States. The general counsel of the Thomson-Houston company immediately sought an interview with the Mayor and the Board of Electrical Control, and strongly objected to such action, declaring that the city officials discriminated against the smaller companies in favor of the large concerns.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Dec. 10, 1892.

The Armington & Sims Engine Company, Providence, R. I., has recently issued a new catalogue of its engines.

The Brockville Electric Light Company is about to purchase additional machinery and otherwise enlarge its plant.

The Pettingell-Andrews Company has been appointed New England agent for the sale of the Interior Conduit Company's product.

The General Electric Company has recently issued a new price list of supply and repair parts of electric railway and power station apparatus.

The B. F. Sturtevant Company, Boston, Mass., has printed a second edition of 10,000 copies of its 200-page general catalogue No. 61, which describes the uses of the Sturtevant blowers, exhausters, engines, forges, and heating and ventilating apparatus.

"Transmission of Power by Leather Belting" is the title of a catalogue bound in leather issued by the Jewell Belting Company, of Hartford, Conn. In addition to descriptions of its goods, the book contains directions for the lacing, care, and use of belts.

The Corliss Steam Engine Company, Providence, is building a 500-h. p. cross compound condensing engine for the American Screw Company. The cylinders are 20 and 36 inches in diameter, with a four-foot stroke. The flywheel is 16 feet in diameter with a 62-inch face.

The Brown Electric Company was organized Dec. 10 under the laws of Massachusetts. M. W. Brown, general manager, will open a store on the corner of Summer and Federal streets, Boston. A general line of electric light and railway supplies will be carried.

The Canadian Association of Stationary Engineers has elected the following officers for the ensuing term: President, A. Ames; vice-president, W. Chambers; secretary, Joseph Ogle (Branton, Ont.); treasurer, L. A. Fordham; conductor, F. Temperence; doorkeeper, A. McKinnon; trustees, A. Ames, T. Pilgrim and J. Nichols.

The Narragansett Electric Light Company, Providence, R. I., will extend its present equipment by the installation of a 1,600-h. p. triple-expansion condensing engine, cylinders 22, 36 and 52 by 48-inch stroke with attached air pump furnished by the E. P. Allis Company. The engine is designed to run at 90 revolutions per minute. The flywheel is 20 feet in diameter with an 80-inch face. The installation of this engine will make the aggregate capacity of the station something like 4,000 h. p.

A recent note in one of the electrical papers it is stated that Mr. T. H. Bibber, formerly general manager of the Consolidated Electric Manufacturing Company, is general manager of the American Magne Electric Company. We are requested to say that this is a mistake, as Mr. Charles E. Bibber is and has been the general manager of the Consolidated Electric Manufacturing Company. Mr. Thomas H. Bibber has been, up to recently, connected with this company as traveling salesman, but has now assumed the general managership of the American Magnetic Electric Company.

W. R. Fleming & Co.—The rapidly increasing business of this firm in Central and New England States has made it necessary for them to open a branch office in Boston to look after that trade. They have obtained offices in the Hathaway Building, 620 Atlantic avenue, and have secured the services of Mr. Walter W. Jones as manager. Mr. Jones is a man of long experience in the highest grades of steam engineering work, and is well known throughout the New England States. He has already secured several contracts and has other large work in hand Since the reorganization and re-equipment of the Harrisburg Foundry and Machine Works, the class of work turned out as shown in both simple and compound Ide and Ideal engines compares with, if not exceeds, the best shown in engineering work of similar lines. There has been almost constant work day and night to keep up with increasing orders and contracts, and further extension of plant is contemplated to take care of present and prepare for future work.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Dec. 10, 1892.

The Central Union Telephone Company has moved its office to the Ashland Block, where a very fine suit of rooms has been fitted up. The immense business being done by the Chicago Telephone Company made this change necessary, the latter company requiring all the space in the "Telephone" building, at 230 Washington street.

Mr. Charles H. Perry, of St. Louis, representing the National Brotherhood Electrical Workers of America, called at the Chicago office of THE ELECTRICAL WORLD on Tuesday last. At the recent convention held by this association arrangements were made for a very complete system of insurance, and Mr. Perry has been given charge of a publication that is to be sent out in that interest.

South Chicago wants an entrance to the World's Fair grounds at Sixty-seventh street. A few nights since a meeting was held to work for this end by citizens of South Chicago, Windsor Park and Cheltenham. Edward C. Kemble was elected chairman. The South Side Electric Street Railway was built to this point on the understanding, as alleged, that an entrance was to be provided on the south side of the grounds.

The Calumet Electric Railway Company in August provided for a $1,000,000 bond issue, which was subscribed by a local banking house. The bonds run for twenty years, but may be redeemed in five years at 105 and in ten years at 110. Saturday last a trust deed to secure the payment of principle and interest was filed for record in the Cook County Recorder's office. It covers the entire plant of the road, including franchises and real estate.

Mr. J. W. Marsh, vice-president and general manager of the Standard Underground Cable Company, Pittsburgh, has been in Chicago and vicinity for some days. Mr. Marsh is on a tour of inspection, his company having secured through Fred. Degenhardt, manager of the Chicago agency, three very large contracts, that are now under way, as follows: The Chicago Telephone Company, 175,000 feet of telephone cable; the Omaha & Nebraska Telephone Company, cable for the complete installation of the telephone system for the city of Omaha, and the cable for the complete installation of the Indianapolis Light and Power Company's plant.

The trolley system is soon to be introduced on a number of southside streets, arrangement already having been made for the change on nearly all of the cross town lines. Contracts have been let to the Westinghouse company for the entire electric equipment, and ninety motors have been delivered. The following streets are included in the system: Thirty-fifth street between State street and California avenue, a distance of about three and one-half miles; Forty-seventh street, from Cottage Grove avenue to Western avenue. Sixty-first street from State east to Midway plaisance, and the Illinois Central railway, ending at South Park Court, Sixty-third street, between Cottage Grove avenue and Lake avenue, where two loops will be built around Sixty-second and Sixty fourth street. The cars will all be equipped with the McQuire steel trucks, which are now being made at the company's factory on North Sangamon street, this city. Power will be furnished from the new plant now being erected at the corner of Wabash avenue and Fifty-second street, in the rear of the cable power house. The expenditure for the plant will exceed $500,000, but the company will have a power house sufficient for all future needs of the road. The building that is now going up is 125 × 145 ft. in dimensions, and of one story, although from the outside it will have the appearance of two. The district is devoted to residences, and the structure has been planned with this in view. The exterior will be of pressed brick with terra-cotta trimmings and bas-relief moldings. A high arched entrance and glazed tiling finish in the interior will add to the attractiveness.

CANADIAN NOTES.

OTTAWA, Dec. 10, 1892.

Cobourg, Ont., has asked for tenders for the street lighting of the town, and also for an electric plant with a capacity of 30 lamps, 2,000 c. p. Cobourg is now in darkness.

The Brantford Electric Lighting and Power Company has elected the following directors: Messrs. William Buck, George Schultz, Dr. Digby, H. B. Leeming, George Wilkes and Robert Henry.

Vancouver.—The Electric Railway and Light Company, of Vancouver, B. C., have requested to have the city guarantee the company's 5 per cent. bonds for $600,000 for 25 years. The existing bonds of the company are carrying interest at the rate of 7 per cent.

Calgary, N. W. T.—Application is being made to the Parliament of Canada for a charter to construct a street railway and tramway along the streets of the town of Calgary, such railway to be propelled by horse, electric or steam power as the applicants may desire.

London, Ont.—The detailed amended proposal of the old street railway company has been laid before the Council, its principal feature being that the company, in case its scheme is accepted, will sell full fare tickets at the rate of eight for 25 cents, with the privilege of reverting to the old rate at the end of five years, in which case they will pay the city 6 per cent. on all receipts up to $100,000, the percentage to be increased on receipts above that amount.

The County Council of York has granted the right of way on the Kingston road from the Woodbine corner to Highland Creek to the Toronto & Scarboro Electric Railway and Lighting Company providing the rate of passenger fares shall not exceed three cents per mile from Toronto to Scarboro Junction, and two cents per mile for the remainder of the distance. The line of railway will be extended one mile into the county of Ontario, as the York Roads Company owns that extent of road in the county.

Hamilton, Ont.—Two of the schemes for constructing radial electric railways from Hamilton to surrounding points are applying to the City Council for indorsement of their applications for charters. The Hamilton Radial Electric Railway Company, which is the concern launched by John Patterson, is first in the field, its request having come before the Council at its last meeting and been referred to the Finance Committee. The other comes from the Hamilton, Watertown & Guelph Electric Railway Company.

The Bell Telephone Company, of Winnipeg, is endeavoring to secure a monopoly in that city for five years. The City Council is now considering a proposal from F. G. Walsh, manager of the Bell Telephone Company, respecting that company's proposition to establish a metallic circuit on condition that the city agrees not to grant a permit to any other company to construct and operate a telephone system in the city during the ensuing five years. A draft by-law will be submitted to Council embodying the above terms.

Montreal.—A successful public exhibition of the Strowger automatic telephone attachment was given here recently. A number of telephones throughout the city were connected with an improvised exchange in the Temple Building on St. James street.

A Montreal company which had been formed under the name of the Automatic Telephone and Electric Company, of Canada, with H. M. Linnell, of the Edison Electric Company, as managing director, has acquired the Canadian rights, and will construct and equip exchanges with the new system.

Vancouver, B. C.—Messrs. Creau & Thomas, of the Hotel Oriental, recently installed an isolated plant for the use of their various hotels. The plant was furnished by the Edison company, and the dynamo is driven by a 35-h. p. Pelton water wheel, automatically regulated so as to run without attendance further than the occasional inspection of a watchman. The water is supplied from the street main by a 4-inch pipe at a pressure of 150 pounds. The automatic regulation is so close that when the water pressure drops 30 pounds the voltmeter scarcely indicates it. As a result of the success of this plant, two similar ones have been ordered.

Hon. J. A. Ouimet, Minister of Public Works, recently heard the application of the Canada Electric Light Company, of Montreal, for permission to dam the Black River, at Isle Visitation, near Sault au Recollet village. The application was opposed by the Montreal Water and Power Company on the ground that the dam would affect its own water supply further down the river, and that the proposed works would impede the rafts in their descent. The Minister reserved his decision after hearing the argument. The Canada Electric Light Company proposes to operate under an old charter obtained by the late Hon. L. A. Senecal.

Oxford Mountain.—Messrs. G. Stevens, managing director and G. G. Foster, chief contractor of the Oxford Mountain Railway, and Charles R. Hosmer, manager of the Canadian Pacific Railway Telegraph Company, recently went over the line of the Oxford Mountain Railway from Eastman to Richmond. Mr. Hosmer's visit had reference to the construction of a telegraph line between those two points by his company. It is understood that arrangements were practically concluded by which the Canadian Pacific will build a telegraph line between Richmond and Eastman, provided the railway company will furnish the poles and string them along the track.

The Township of Etobicoke is in a unique position. After passing a by-law granting $20,000 to the Toronto & Mimico Electric Railway, and sustaining the by-law when the measure was attacked in the courts, the township need not pay the bonus if it chooses. Z. A. Lash, in the Court of Appeal, appeared on the appeal of Joseph Adamson against Chief Justice Galt's decision last summer refusing to quash the by-law. As the promoters of the railway had not completed the line by Oct. 31, the limit set within which to obtain the bonus, the court refused to hear argument until it is shown that there is actually some money at stake, the object of the by-law having apparently been lost by default.

The Royal Electric Company, of Montreal, is to have a rival in the Central Electric Light Company of Montreal (Limited), the prospectus of which has been issued. The capital stock is $500,000 in 5,000 shares of $100 each. The provisional board of directors are Messrs. Louis Perrault, chairman; H. Beaugrand, E. M. Lovelace, J. O. Dupis and Treffle Berthiaume. The company proposes supplying electric light and electric motive power and heat throughout the city. The company, in view of the fact that the Royal Electric stock is quoted at 220 after three years' operation, believes that that there is room for a competitor. The prospectus says that it will acquire the plant of Mr. Louis Perrault.

Montreal.—At a recent meeting of the Light Committee, it was decided to give the contract for lighting the city during the next ten years to the Royal Electric Company. The rates are as follows, subject, of course, to certain conditions: For the first five years, 34 cents per lamp for each night, making $124 10 per annum; for the three years following, 33 cents per lamp each night, or $120.45 per annum; for the balance of the term, viz., two years, at the rate of 32 cents per lamp, or equal to $116 80 per annum. Each lamp is supposed to have a nominal power of 2,000 candles, making with certain reductions, an average of $119 35½ per lamp per annum. The company likewise engaged to put its wires under ground.

Toronto.—A meeting of the stockholders of the Toronto and Scarboro Electric Light and Power Company has been held when the following directors were elected: D. G. Stephenson, East Toronto; Ald. Hallam, J. F. McLaughlin, W. T. Murray, J. J. Foy, Q. C., Robert Davis, J. P. Murray, John Stark, H. M. Pellett and A. W. Dingman. The officers elected were: President, D. G. Stephenson; vice-president, Ald. Hallam; managing director and secretary, A. W. Dingman; solicitors, Rowan and Ross. The general policy of the company was discussed and it was agreed that the work of construction should be vigorously pushed. The road from the Woodbine to Little York and East Toronto will be built and put in operation this fall.

The Canadian General Electric Company, of Montreal, which controls the Edison, Thomson-Houston, Fort Wayne, Wood, Van Depoele and many other systems of electric railways, electric light and electric power, is a Canadian enterprise which is now giving employment to some seven hundred persons in its various branches. Contracts for electrical machinery and apparatus to the value of about $300,000 are in hand, and orders to the value of $200,000 have been secured during the last month. Many well-known Canadians are at the head of this enterprise. The recent decision of the United States Court of Appeals awarding Mr. Edison the monopoly of the manufacture of the incandescent lamp is of great value to the Canadian Company, as it owns these patents in the Dominion of Canada.

Victoria, B. C.—A Toronto gentleman interested in the electric street railway in that city has been making an inspection of electric roads in other cities. With regard to the Victoria (B. C.) road he says that the electric street railway cars put on the lines in Victoria are much larger and more commodious than those in use in Toronto. No open cars were employed, but the closed carriages would seat 36 persons, and in a pinch hold 100. Although the cars ran at a much higher rate of speed than in Toronto, frequently attaining a momentum of 15 miles an hour, accidents very seldom occurred. Two fatalities for the past three years were recorded, and in both cases the victims were children. Vancouver City and New Westminster were connected by a splendid electric service. Though the grades were heavy between the two towns, the distance, 14 miles, was covered in 50 minutes.

Hamilton, Ont.—MacKelcan, Gibson, Bausby, Gausby & Martin have applied to the Lieutenant Governor for a charter for a company to generate or purchase electric power from Niagara Falls or elsewhere, and to sell or otherwise distribute the same for manufacturing, heating, lighting, traction or other purposes. The company also purposes to construct and operate radial railways from Hamilton to Elmira, Dundas, Galt, Preston, Berlin, Waterloo, St. Jacob's, Mount Forest, Guelph, Watertown, Oakville, Bront, Burlington, Hamilton Beach, Brantford, Ancaster, Dunnville and Welland; also to lease and operate street railways in various municipalities. The capital stock is put at $2,000,000, and the provisional board of directors includes Messrs. C. M. Counsel, Adam Zimmerman, J. H. Tiden, W. J. Copp, W. A. Wood, John Patterson and Thomas Patterson, Jr., and Nathaniel Dyment, of Barrie.

Bell Telephone Company.—This company has completed a line between Toronto and Guelph, Ontario, and has in course of construction lines from London to Chatham, and Belleville to Picton; new metallic wires from Guelph to Galt, Guelph to Hamilton, and Hamilton to Paris, Brantford, Woodstock, Ingersoll and London; a line from Alliston to Collingwood, and wires connecting the towns and villages of Aberfoyle, Atwood, Blyth, Campbellville, Cottam, Creemora, Everett, Everton, Glencairn, Jordon, La Fontaine, Lisle, Milton, Morriston, Muirkirk, New Dundee, Randolph, Rockwood, Schaw, Sheffield, Springfield, Sutherland's Corners and York Mills with the general system. The company has decided during 1893 to run wires from Toronto to Barrie, Toronto to Orangeville, Toronto to London via Guelph and Stratford; Chatham to Windsor and Hamilton to Niagara Falls to complete the line from Detroit and Windsor through London and Hamilton to Niagara Falls and Buffalo.

Hot Water Coils Heated by Electricity.—The first practical use of electricity to heat hot water coils, the inventor claims, was made recently, when R. A. McCormack, of Ottawa, Ont., installed the Ahearn electric heaters in his store. The switch was turned on at 6:30. The temperature was then 50 degrees. In 20 minutes the cold was out of the pipes, and at 9 o clock the temperature had risen to 68 degrees. The water for the coils is contained in five heaters in the cellar, the total capacity being about 23 gallons. As in the regulation heaters, the water is heated by coils of wire of poor conductivity, that pass between the inner and outer sheets of the heater. The hot water is then forced up by the laws of hydrostatics to the coils above. By having five separate heaters the heat and expense can thus be regulated. On a mild day one or two sections may be used. About 300 feet of pipe are used in the store proper, and the heaters keep the cellar warm. Mr. McCormack says the beauty of the system is that it takes up only one quarter of the space of a furnace and boiler, requires no bother with coal or ashes, and the cost of putting in is less than half that of a furnace.

London, Ont.—When considering the offer of the new company to construct an electric street railway in this city the president of the present street railway company objected to the frequent crossing of the railways, and his view is confirmed by the decision of the Railway Committee of the Dominion Privy Council on the application of the Davenport (Toronto) Electric Railway to cross the tracks of the Grand Trunk and Canadian Pacific railways. The committee approves of the proposed places of crossing, but orders that gates be provided at both points by the Davenport Street Railway Company, these gates to be interlocked with a home signal, located on the C. P. R. and G. T. R. as the case may be, and worked from a signal box. A signalman is to be constantly on duty at the points named. The signalmen employed are to be servants of the C. P. R. and G. T. R., but their salaries and other charges connected with the construction, maintenance and operation of the crossings by the Davenport Electric Railway Company are to be paid by the electric road. No electric car must approach within 400 ft. of the crossings at a greater speed than six miles an hour and all the appliances put in must be approved by the Chief Engineer of Government Railways.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Nov. 30, 1892.

Worcester.—The town council of Worcester has decided to make use of the water power available in that city and to spend some £30,000 on an electric light scheme.

Electrical Communication with Lighthouses.—I hear that Mr. Preece's experiments on "induction" telegraphy, which he has recently been carrying out on the Welsh coast, have met with considerable success. He erected a line three miles long close to the shore and another about half a mile long on an island three miles distant, the two wires being parallel. Signals passed into the line wire were completely recognizable on the island three miles distant. Mr. Preece, I may say in passing, has been appointed engineer in chief to the Post Office in place of the late Mr. Edward Graves.

The Hopkinson Three-Wire Patent.—After more than a fortnight's adjournment, the hearing of the action brought by Dr. John Hopkinson against the St. James & Pall Mall Electric Light Company, for the infringement of his three-wire patent No. 3,576, of 1882, was resumed yesterday before Mr. Justice Romer, in Chancery Court III. The case had been adjourned for this lengthy period owing to the fact that on Monday, Nov. 7, the defendants suddenly brought forward what appeared to be an undoubted case of "prior user." On the case being recommenced, the witnesses in support of the "prior user" were mercilessly cross examined by Sir Richard Webster and their evidence considerably shaken. The case now appears to be proceeding to the satisfaction of both parties.

The Safety of Electric Lighting.—There have been several alarms with regard to the safety of the electric light within the last few days. The shop front of a photographer on Regent street was burned out on Wednesday evening last, and as the incandescent lamps were left alight all night, the chief of the Metropolitan Fire Brigade attributed the fire to them; but with what truth it is difficult to ascertain. A day or two afterwards a flaming paragraph appeared in a sensational evening paper calling attention to the danger run by the British Museum on account of the arc lighting of that building and giving a most sensational description of glass splinters and red hot carbon cinders falling from one of the lamps on the heads of the unfortunate readers below. It is needless to say that the "accident" was of the most insignificant description and that there was absolutely no danger of fire at any time. It is interesting to state in passing, that the arc lights at the British Museum are of a somewhat abnormal type, being Siemens' differential 30 ampère lamps, which are run two in series on a 120-volt constant potential circuit with but little resistance in series. Under the circumstances it is surprising that the light is as steady as it actually is. Following these two episodes, a fire is now reported to have occured at the Carnaby street central station of the St. James & Pall Mall Company. I should not be surprised if the cumulative effect of these individually insignificant mishaps were to create a scare with regard to electric lighting.

Electric Traction.—It would seem as if the inauguration of the electric motors on the South Staffordshire system was going at last to overcome the inertia of our tramway companies with regard to the adoption of electric traction. The chairman of the Birmingham Central Tramway Company, a company which has met with a decidedly qualified success in connection with its accumulator cars, is stated to have said that he considers it prudent to keep an open mind as to the advisability of using electric instead of cable traction. He is also stated to be of opinion that if overhead wires were permitted in Birmingham the Central Tramways Company would prove "a gold mine" to the investor. With a view no doubt of converting them to this way of thinking, the mayor and corporation of Birmingham have been invited to inspect the working of the South Staffordshire cars with their own municipal eyes. At Coventry also there is an agitation for the substitution of electric in place of steam cars and Mr. Graff Baker, the representative of the General Electric Company in this country, is in active negotiation with the powers that be. A deputation of the Coventry Town Council visited Leeds for the purpose of inspecting Mr. Graff Baker's line and returned, it is said, with their views as to the objections to overhead wires much modified. The historic line at Blackpool, which has now come under the control of the municipality, is to be extended and a similar line is to be laid down in the neighborhood of that Lancashire watering place. On the other hand, for reasons not obvious on the surface, no progress whatever has been made with the Central London underground tubular electric railways, for which Parliamentary powers were obtained some two years ago.

News of the Week.

THE ELECTRIC LIGHT.

Lake City, Mich., wants the electric light.

Traer, Ia., will soon be lighted by electricity.

Halstead, Kan., is completing an electric light plant.

Wamego, Kan., is to illuminate its streets by electricity.

Clay Centre, Kan., is to be lighted by electricity within 30 days.

Vacaville, Cal., has one of the finest electric light plants in the interior of the State, and with the addition of an arc dynamo will be able to light its own streets.

The Onondaga Electric Light Company, Syracuse, recently organized at Syracuse, has rented offices in the Herald Building and expects to occupy them Jan. 1, 1893, or may be sooner. Early in the spring it will start work in the power-house for its plant and string the wires ready for business. The building will be brick and three stories high, and cost $20,000, and will have a capacity of 480 arc lights, 10,000 incandescent lights. There will be 16 steel boilers of total horse power of 1,800. There will be four Wood generators, 120 h. p. each; three Wood arc light generators, 80 lights each; two Edison and two Slattery alternating incandescent generators. The total cost of the plant will be about $250,000. The stockholders are prominent business men: R. T. McDonald, Wm. B. Kirk, G. M. Barnes, C. M. Warner, A. J. Belden, M. J. Myers, P. B. McLennan, J. McLennan, W. D. Andrews and A. N. Palmer.

THE ELECTRIC RAILWAY.

Providence, R. I.—All the street car lines in the city have decided in favor of the trolley system, which will be installed as soon as practicable.

The Montgomery (Ala.) Electric Railway, which is being built by the New York Electrical Engineering Company, will be completed by Jan. 1.

The Kentucky & Indiana Bridge Company is planning to operate an electric railroad across its bridge from New Albany Ind., into Louisville.

The citizens of Mount Vernon (N. Y.), at an election held on Friday and Saturday of last week, voted to give the Union Electric Railway Company the first choice of a route, thereby declaring a strong preference for a five-cent fare to 129th street, New York.

The Kings County Electric Railway Company of Brooklyn has filed an extension of its route as follows: From the town line between the towns of Flatbush and Flatlands, at Church avenue and "the road from Flatlands and Canarsie," along the road to Canarsie avenue, along Canarsie avenue to Denton avenue at or near Jamacia Bay; also along the King's Highway from Ocean avenue to the town of New Utrecht; a total length of four miles. The certificate is signed by P. H. Flynn, president, and Fred. C. Cocheu, secretary.

Hartford, Conn.—Interest in suburban car service was greatly stimulated during the past week by the proposal of at least four companies to apply to the next legislature for charter privileges to reach Hartford. The Hartford & Wethersfield Horse Railroad Company is the first of these. A new company proposes to operate from Collinsville, Unionville, Farmington and West Hartford, and make connections with the old line. The New Britain Tramway Company is already getting its line ready to Plainfield and into New Britain, and desires a franchise into Hartford.

LEGAL NOTES.

Defective Brake Will Not Defeat a Recovery.—The Missouri Supreme Court lays it down that where a petition charged negligence of the driver of a street car in prematurely starting it while plaintiff was alighting, and the evidence supported the charge, the fact that a defective brake contributed to the injury will not defeat a recovery, and constitutes no variance.—Buck v. People's Street Railway and Electric Light and Power Company, 18 Southwestern Rep., 1,090.

Right of a Taxpayer to Enjoin a City from Paying for Electric Lights.—The Supreme Court of Iowa lays it down that in an action to enjoin a city from paying for lighting by electricity, a statement in the petition that plaintiff is a taxpayer on property subject to assessment, under an ordinance providing for such expenditure out of the general fund, instead of by special taxation on property benefited, is a sufficient averment of injury to entitle plaintiff to maintain his action, if the grounds thereof are well founded.—Hanson v. Hunter, 53 Northwestern Reporter, 84.

Fundamental Railway Patents.—Benson Bidwell, of Rochester, has brought two actions against the Toledo Consolidated Railroad Company for an alleged infringement of Bidwell's patents for running electric cars and the principle involved in the use of underrunning spring contact; also, that the patents for the running and lighting of cars with the same current of electricity and the lighting of streets and houses along the line from the current which propels the cars have been infringed upon. Charles F. Bidwell, of Toledo, is interested in the patents of his father, Benson Bidwell, and has been working for the past three years with a view to bringing suit against the street railway companies which, he claims, have been infringing upon them. The Consolidated is to be a test suit.

Linemen Should Inspect Cross-Arm Before Placing Weight Upon It.—In New York in an action against a telegraph company for the death of a servant, it appeared that deceased, while working as lineman on one of defendant's telegraph poles, leaned his weight on one of the cross-arms so that it broke, causing him to fall and resulting in his death. The arm had been in use about six years, during which time it had answered its purpose, and it did not appear that there was any defect in it discernable by an ordinary inspection. Defendant's inspectors were not required to climb each pole and examine the arms, and deceased knew this, having been employed by defendant for several years—part of the time as an inspector and the rest of the time as a line-

man. The Court of Appeals lays it down that deceased should have inspected the arm before putting his weight on it, and that a verdict for plaintiff could not be sustained.—Flood v. Western Union Tel. Co., 30 Northeastern Rep., 196.

PERSONALS.

Mr. A. L. Register, of the firm of Pepper & Register, of Philadelphia, was in the city last week on business. This firm now has considerable construction work under way, and more in view.

Mr. C. H. Thompson, Syracuse, N. Y., last week was very unfortunate in having considerable loss by fire. His home and most of his furniture, of a value amounting to several thousand dollars, were destroyed. Mr. Thompson is a well known electrician and dealer in electrical supplies. He had very little insurance on the property.

Mr. John Carroll, the secretary and treasurer of the Eugene Phillips Electrical Works at Montreal, was married on the 7th inst. to Miss Emily S. Ryan, of Newport, R. I. Mr. Carroll is well known to the electrical fraternity in this country, through his interest in the meetings of the National Electric Light Association and his connection with the Eugene Phillips Electrical Works.

Industrial and Trade Notes.

Gaston, Weston & Ladd, 15 Murray street, New York City, manufacturers of the well known polish "Prestoline," are very busy filling orders.

American Bolt Company, Lowell, Mass., reports considerable business for the past month from various street railway companies and motor builders.

The Edw. C. White Manufacturing Company, 556 East Thirty-fourth street, New York City, manufacturer of car trucks etc., reports business as very active.

The Dahl Electric Company, 136 Liberty street, New York City, manufacturer of the "Success" arc lamp, is flooded with orders. The company is also experimenting upon a new motor.

Locke Brothers, of Salem, Mass., recently filled a large order for regulators, aggregating $2,200, in ten days. The order included two for a 12-inch service. The works have been running night and day.

Medical Coils.—Dr. N. B. Lewis, of Troy, N. Y., writes, Feb. 19, 1892, to Jerome Kidder Manufacturing Company, 820 Broadway, New York City: "I think you have the best coil on the market to day."

The L. P. & D. Transmitter Company, Montpelier, Vt. has sold recently to the Lakota Building, Chicago, five transmitters, Janesville Electric Light Company, two, and one to the Forest City Electric Company, Rockford, Ill.

Laminar Fibre Goods Company, Boston, Mass., is meeting with success in the sale of its fibre gears and pinions. These are, it is claimed, as noiseless as raw hide and are being extensively used by motor builders for street railway purposes.

The Light and Water Company, of Herkimer, N. Y., has purchased a 50-light Edison arc dynamo of the General Electric Company, which will increase their capacity from 50 to 100 lights. J. M. Kelley is the electrician of the company.

Mr. David S. Grey, Newark, N. J., representative of the Mather Electric Company, recently installed a 100-light dynamo in the large dry-goods house of Hahne & Co., and during the past week also sold one 450-light dynamo to the same firm.

The Lodge & Shipley Machine Tool Company, of Cincinnati, O., is meeting with wonderful success on its new pulley lathes, gear lathes and turret lathes. It has orders sufficient to keep it running for two months and is constantly increasing its working force.

The Electric Heat Alarm Company, Boston, Mass., is doing considerable work in equipping factories and work shops with its improved heat alarm. It is at present equipping a shoe factory at Haverhill with 150 fire alarms, and has an order from London, Eng. for 30 fire alarms and 10 cold alarms.

The New York Electrical Works, 161 Washington street, New York City, has made improvements in its quarters on account of the demands of business. Among the novelties manufactured by it is an arc lamp for theatrical use to take the place of calcium lights. It is the invention of Mr. John Thompson.

Mr. W. R. Brixey is having placed in the factory at Seymour, Conn., a 50-h. p., New York Safety Steam Power Company's engine to be used in driving his recently equipped 400-light Edison plant. This will give him the opportunity of using either water or steam power, as desired, in the generation of electricity.

The Turbayne Electrical Specialty Company is the successor of Liggett, Turbayne & Co., 54 Grand River avenue, Detroit, Mich. Mr. John C. Liggett has retired from the business, his place being taken by Mr. Charles Tamblyn. The new firm will add another floor to its factory and anticipates doing a large business.

The Electric Appliance Company of Chicago has put in a large stock of electrical toys and novelties for the holiday trade. It made a special feature of this business last year, and met with quite a large success, getting out a special catalogue of this class of material and advertising in periodicals and magazines. The results were so satisfactory that the company is going into it still further for the coming season.

The Franklin Electric Company is exceedingly busy handling the Irving system of storage batteries. It is said that so far as installed (and these batteries are now quite extensively used) excellent satisfaction has been given. Recent installations have been made at Oil City, Pa., and Newark, N. J. A novelty recently brought out by this company is a cornet, upon the bell shaped trumpet of which is placed five tiny incandescent lights which are supplied with current from a storage battery carried, of course, through concealed wiring.

The Wainwright Manufacturing Company has recently furnished 600-h. p. feed-water heaters and condensers for use in the grain elevator which is being constructed by the Boston & Maine Railroad Company. The Wainwright Manufacturing Company report among their recent sales the following: Mitchell Electric Light Company, Mitchell, S. Dak., 200 h. p.; Robert Bishop, Newton Lower Falls, Mass., two 400 h. p.; Ball Engine Company, Erie Pa., 150 h. p.; Bennington Electric Light and Power Company, Bennington, Vt., 200 h. p.; Middletown Electric Light Company, Middletown, Pa., 200 h. p.; Ashland Electric Light Company, Ashland, Wis., 500 h. p.; Massachusetts Charitable Mechanics' Association, Boston, Mass., 600 h. p.; Cooperstown Electric Railway Company, Cooperstown, N. Y., 150 h. p.; Wilmington City Electric Company, Wilmington, Del., 1,000 h. p.; Burlington Electric Light Company, Burlington, Ia., 600 h. p.; Lowville Electric Light Company, Lowville, N. Y., 100 h. p.; Owatonna Electric Light Company, Owatonna, Minn., 200 h. p.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Oil Filter for sale cheap; send for prices to Purity Oil Filter Manufacturing Company, 901 Water street, Pittsburgh, Pa.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

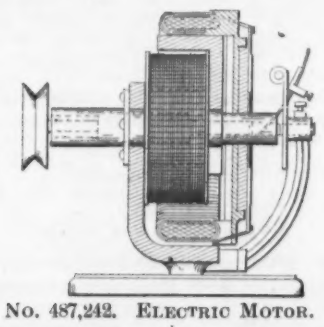
UNITED STATES PATENTS ISSUED DEC. 6, 1892.

487,242. Electric Motor; Franklin H. Bears, Newark, N. J. Application filed Feb. 26, 1892. In an electric motor having a revolving armature, one field magnet pole mounted interiorly to such armature, the field magnet poles being arranged on opposite sides of the axis of motion. (See illustration.)

487,285. Electrical Heater; Willis Mitchell, Malden, Mass. Application filed March 15, 1892. A stove or furnace partly or wholly composed of magnetic material and provided with inwardly extending studs of the same, in combination with a wire wound thereon and forming part of an electric circuit.

487,302. Method of Electric Welding; Elihu Thomson, Swampscott, Mass. Application filed Oct 2, 1890. The method of electric welding, which consists in placing pieces together for union by electric heat and pressure, and in combining the currents passing through the smaller pieces and through the joint to traverse summatively the larger piece or pieces, and thereby increase the heating effect in the larger piece to the amount required to complete the joint.

487,306. Resistance Box; John Waring, Manchester, Conn. Application filed April 28, 1892. A resistance box consisting of a bottom having a chamber for the resistance coils and a chamber for the contact plugs separated by insulation, with perforations through the top to coincide with the plug-sockets between the blocks.



No. 487,242. Electric Motor.

487,307. Connection for Commutators and Armature Wires; Ernest P. Warner, Chicago, Ill. Application filed March 5, 1892. The combination with the connecting wires inserted in holes in the commutator segment of a plate adapted to rest upon the wires and a screw adapted to bear by its end on the plate, whereby the pressure of the screw is distributed equally between the wires.

487,315. Electric Arc Lamp; James J. Wood, Fort Wayne Ind. Application filed July 25, 1892. In an arc lamp, in combination with a fixed clutch-releasing abutment, a feed clutch consisting of a sleeve embracing the feed-rod and a clutch lever pivoted to the sleeve, having a brake shoe engaging the rod, an arm connected to the feed regulator, and a tail adapted upon the lowering of the clutch to strike an abutment, and thereby tilt a lever in the direction to release the clutch. (See illustration.)

487,324. Galvanic Battery; James L. Gethins, Boston, Mass. Application filed May 15, 1891. A galvano-electric battery comprising in its construction a jar or cell, a porus cup in the cell, a zinc electrode consisting of a cylindrical portion surrounding the sides of the cup, and a plurality of radiating wings underneath the cup.

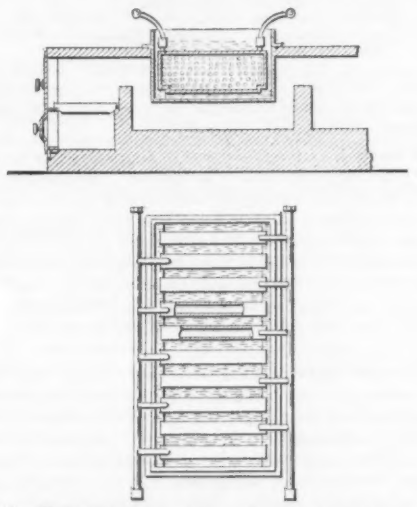
487,329. Electric Motor for Cars; Charles Alman Jackson, Reading, Mass. Application filed Aug. 3, 1891. In an electric propelling device the combination of a sliding rod having projections, a gear wheel and lever adapted to operate the clutch ring and recessed rings, buttresses, a clutch roller and oscillating clutch ring.

487,332. Clamp for Electric Conductors; Henry Lindahl, Chicago, Ill. Application filed Feb. 5, 1892. A wire clamp or holder consisting of two plates secured together by the engagement of tongues or dogs.

487,356. Apparatus for Distribution of Electricity; Thomas Tomlinson, London, England. Application filed May 25, 1891. In apparatus for connecting and disconnecting transformers or other electrical units, the combination of parts consisting of contact arms and contact parts in connection therewith; weighted rocking levers operating on the arms to close and open the contacts and a wedge piece and carriage for it, which in traversing causes the levers to fall over from side to side.

487,360. Incandescent Electric Lamp; Eugene W. Applegate, Omaha, Neb. Application filed Feb. 29, 1892. An incandescent lamp provided with stem-opening and a flanged stock, a cap adaped to fit within and upon the stock, provided with a central tube and two or more projecting clamps of carbon, the cap and lamp forming an air-tight seal, and a threaded spring-sleeve secured to the stock, in combination with a socket comprising a shell, spring-actuated contact arms, adapted to be in electrical connection with the carbon clamps, J-shaped spring arms and a key.

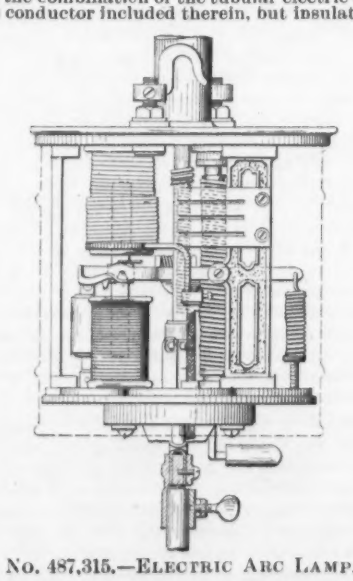
487,369. Telephone Holder; Everett C. Lewis, Woonsocket, R. I. Application filed April 29, 1892. A telephone holder comprising a base piece, bracket mounted pivotally on same, a block bracket, a bent rod sliding on the block and having a friction spring mounted in the block, a head piece mounted on the rod, and a holder having a shank pivotally mounted in a head piece and provided with a support having adjustable spring fingers for the reception of the head of the telephone receiver.



No. 487,644.—Process of and Apparatus for Generating Electricity.

487,437. Electric Bell; Peter Wagner, New York. Application filed Oct. 2, 1891. In an electro-magnetic bell apparatus diagonally arranged magnets, each constructed with a space between the coils exposing the cores, in combination with a swinging armature arranged between these magnets, its shaft passing centrally through the cores within the spaces, and a striker and bell operated by the armature.

487,448. Jail; D. K. Osbourne, St. Paul, Minn. Application filed Aug. 6, 1891. In a wall or barrier for jails and analogous structures, the combination of the tubular electric conductor and the electric conductor included therein, but insulated therefrom.



No. 487,315.—Electric Arc Lamp.

487,462. Connection Plate for Dynamos; J. J. Wood Fort Wayne, Ind. Application filed April 18, 1892. In a dynamo the combination of commutator brush cables, conducting connectors joined to said cables, the connector adapted for connection with the line circuit, the other line circuit terminal, and the field coils connections interposed between the connectors.

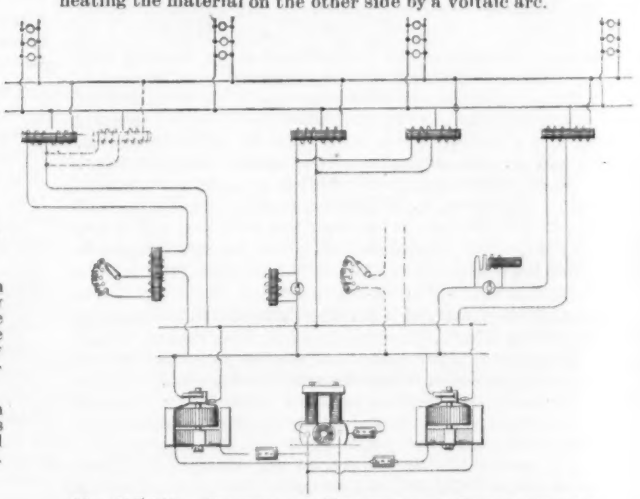
487,476. Incandescent Electric Lamp; G. A. Frei, Springfield, Mass. Application filed April 11, 1892. In an electric incandescent lamp, the combination with a head having insulated metallic pieces and a sealed globe having a filament and leading in wires detachably connected to said metallic pieces, of a ferrule detachably connected to the head and surrounding the connection between the globe and head.

487,477. Incandescent Electric Lamp; G. A. Frei, Springfield, Mass. Application filed March 14, 1892. The filament supporting device consisting of a table having the pivotally united diverging members with hinged legs, handle members with legs, and a spring for normally insuring the divergence of said members, but permitting the approached relations thereof.

487,519. Thermostat; F. A. Elliott, Catawba, N. C. Application filed Aug. 20, 1892. In a circuit closer, in combination, the casing made in two separable parts, one of which carries the fixed and the other the movable contact.

487,543. System of Electrical Distribution; B. Shallenberger, Rochester, N. Y. Application filed Jan. 9, 1890. The combination of a source of electricity, converters having their secondary coils connected with different points along the lengths of the main lines, conductors connecting the source of electricity with the primary coils of the respective converters, and one or more converters having their primary coils respectively included in the last named conductors, and adjustable resistances included in the circuits of the secondary coils. (See illustration.)

487,607. Method of Arc and Incandescent Metal Heating; C. L. Coffin, Detroit, Mich. Application filed Aug. 6, 1892. The method of heating metals electrically, consisting in heating the material on one side by contact with the conductor, in electrical connection with one terminal of a generator and heating the material on the other side by a voltaic arc.



No. 487,543.—System of Electrical Distribution.

487,634. Steam Boiler Indicator; G. L. McDermott Neenah, Wis. Application filed July 26, 1892. The combination of a steam boiler water tube, a cylinder supported above, contact points at the upper and lower end of said cylinder, a float in the tube, a rod projecting therefrom into the cylinder, and contact plates loosely secured to the upper end of the rod.

487,644. Process of and Apparatus for Generating Electricity; J. S. Rogers, New York, N. Y. Application filed April 14, 1892. The process of generating electricity, which consists in exposing a fusible electrolyte capable of being reoxidized while in a state of fusion in the presence of suitable electrodes to a current of deoxidizing gas injected in one direction and to a current of oxidizing gas injected in the opposite direction. (See illustration.)

487,654. Closed Conduit for Electric Railways; A. A. Vanderpool, Newark, N. J. Application filed March 18, 1890. The combination of a trough slotted at the top, conducting wires arranged in said trough, slot closers, clamping plates for holding the same in position, adjusting or setting screws for taking up wear on said slot closers, and a leg adapted to be secured to the car or vehicle, and provided with a foot to engage said conducting wires, and being wedge shaped at its forward and rear parts, and insulated to prevent escape of electricity.

487,655. Electro-Therapeutic Process and Apparatus; J. M. Wardell, Cadillac, Mich. Application filed Feb. 20, 1892. An instrument for therapeutical application of electricity to the vaginal canal, which consists of a syringe having a hollow non-conducting body and an exterior flange or shield, an electrode arranged on the inner end of such body, a water inlet tube arranged within said body, and the water exit tube arranged within the inlet tube and secured to it.

487,676. Electric Signaling Apparatus; M. Martin, Malden, Mass. Application filed Feb. 20, 1892. A signal receiving instrument comprising a paper feeding train of wheelwork and an electro-magnet and armature controlled by the transmitting circuit, one member of which is operated by said train of wheelwork and the other member of which is operated by said electro-magnet

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.